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OFFICE OF WATER RESEARCH AND TECHNOLOGY

SELECTED WATER RESOURCES ABSTRACTS

VOLUME 13, NUMBER 12
JUNE 15, 1980

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SELECTED WATER RESOURCES ABSTRACTS

A semimonthly publication of the
Office of Water Research and Technology
U.S. Department of the Interior

VOLUME 13, NUMBER 12
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W80-03901 -- W80-04200

The Secretary of the U.S. Department of the Interior has determined that the publication of the periodical is necessary in the transaction of the public business required by law of this Department. Use of funds for printing this periodical has been approved by the Director of the Office of Management and Budget through August 31, 1983.

As the Nation's principal conservation agency, the Department of the Interior has responsibility for most our our nationally owned public lands and natural resources. This includes fostering the wisest use of our land and water resources, protecting our fish and wildlife, preserving the environmental and cultural values of our national parks and historical places, and providing for the enjoyment of life through outdoor recreation. The Department assesses our energy and mineral resources and works to assure that their development is in the best interests of all our people. The Department also has a major responsibility for American Indian reservation communities and for people who live in Island Territories under U.S. administration.

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FOREWORD

Selected Water Resources Abstracts, a semimonthly journal, includes abstracts of current and earlier pertinent monographs, journal articles, reports, and other publication formats. The contents of these documents cover the water-related aspects of the life, physical, and social sciences as well as related engineering and legal aspects of the characteristics, conservation, control, use, or management of water. Each abstract includes a full bibliographic citation and a set of identifiers or descriptors which are listed in the **Water Resources Thesaurus.** Each abstract entry is classified into 10 fields and 60 groups similar to the water resources research categories established by the Committee on Water Resources Research of the Federal Council for Science and Technology.

WRSIC IS NOT IN A POSITION TO PROVIDE COPIES OF DOCUMENTS ABSTRACTED IN THIS JOURNAL. Sufficient bibliographic information is given to enable readers to order the desired documents from local libraries or other sources.

Selected Water Resources Abstracts is designed to serve the scientific and technical information needs of scientists, engineers, and managers as one of several planned services of the Office of Water Research and Technology.

To provide SWRA with input, selected organizations with active water resources research programs are supported as "centers of competence" responsible for selecting, abstracting, and indexing from the current and earlier pertinent literature in specified subject areas.

The input from these Centers, and from the 54 Water Resources Research Institutes administered under the Water Research and Development Act of 1978, as well as input from the grantees and contractors of the Office of Water Research and Technology and other Federal water resource agencies becomes the information base from which this journal is derived.

Comments and suggestions concerning the contents and arrangement of this bulletin are welcome.

Office of Water Research and Technology
U.S. Department of the Interior
Washington, D.C. 20240

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01 NATURE OF WATER

Includes the following Groups: Properties; Aqueous Solutions and Suspensions.

02 WATER CYCLE

Includes the following Groups: General; Precipitation; Snow, Ice, and Frost; Evaporation and Transpiration; Streamflow and Runoff; Groundwater; Water in Soils; Lakes; Water in Plants; Erosion and Sedimentation; Chemical Processes; Estuaries.

03 WATER SUPPLY AUGMENTATION AND CONSERVATION

Includes the following Groups: Saline Water Conversion; Water Yield Improvement; Use of Water of Impaired Quality; Conservation in Domestic and Municipal Use; Conservation in Industry; Conservation in Agriculture.

04 WATER QUANTITY MANAGEMENT AND CONTROL

Includes the following Groups: Control of Water on the Surface; Groundwater Management; Effects on Water of Man's Nonwater Activities; Watershed Protection.

05 WATER QUALITY MANAGEMENT AND PROTECTION

Includes the following Groups: Identification of Pollutants; Sources of Pollution; Effects of Pollution; Waste Treatment Processes; Ultimate Disposal of Wastes; Water Treatment and Quality Alteration; Water Quality Control.

06 WATER RESOURCES PLANNING

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07 RESOURCES DATA

Includes the following Groups: Network Design; Data Acquisition; Evaluation, Processing and Publication.

08 ENGINEERING WORKS

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09 MANPOWER, GRANTS, AND FACILITIES

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10 SCIENTIFIC AND TECHNICAL INFORMATION

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ABSTRACT SOURCES

SELECTED WATER RESOURCES ABSTRACTS

2. WATER CYCLE

2A. General

GROUND WATER INTERACTIONS WITH WETLANDS,
Lowell Univ., MA. Dept. of Earth Sciences.
A. L. O'Brien.
Well Log, Vol 10, No 11, p 49-50, December, 1979. 6 Ref. OWRT-B-012-MASS(9).

Descriptors: *Wetlands, *Massachusetts, Swamps, *Ground water, Subsurface waters, Aquifers, *Aquifer characteristics, *Discharge, Effluent streams, *Groundwater movement, *Groundwater recharge, Surface-groundwater relationships, Water table.

Wetlands in Massachusetts commonly occur in association with potential aquifers: stratified drift, lake bottom deposits, and alluvium. The relationship of wetlands to ground-water and the underlying deposit is shown by a water budget analysis of a wetland in eastern Massachusetts. Monitoring showed a close coupling between ground-water and the stream which resulted in rapid groundwater discharge during flood events. In fact, 93% of the total annual discharge was due to groundwater. This rapid ground-water discharge from a shallow upper layer of the ground-water body resulted in high spring discharges and little low flow augmentation in the summer. Such patterns of discharge should be considered whenever groundwater is developed from wetland associated aquifers.
W80-03926

DESIGN OF OPERATIONAL PRECIPITATION AND STREAMFLOW NETWORKS FOR RIVER FORECASTING,
GKY and Associates, Inc., Alexandria, VA.
For primary bibliographic entry see Field 7A.
W80-03939

SAMPLING OF INTERRELATED RANDOM FIELDS: THE RAINFALL-RUNOFF CASE,
Massachusetts Inst. of Tech., Cambridge. Dept. of Civil Engineering.
For primary bibliographic entry see Field 7A.
W80-03940

SOIL SPATIAL VARIABILITY AND ITS CONSEQUENCES ON SIMULATED WATER BALANCE,
Commonwealth Scientific and Industrial Research Organization, Wembley (Australia). Div. of Land Resources Management.
For primary bibliographic entry see Field 2G.
W80-03947

CLIMATOLOGICAL ESTIMATE OF THE AVERAGE MONTHLY ENERGY AND WATER BUDGETS OF LAKE TAHOE, CALIFORNIA-NEVADA,
California Univ., Davis. Dept. of Land, Air and Water Resources.
For primary bibliographic entry see Field 2H.
W80-03953

DISCHARGE RESPONSE ANALYSIS AND HYDROLOGIC SIMILARITY: THE INTERRELATION BETWEEN THE GEOMORPHOLOGIC IUH AND THE STORM CHARACTERISTICS,
Universidad Simon Bolivar, Caracas (Venezuela).
I. Rodriguez-Iturbe, G. Devoto, and J. B. Valdes.
Water Resources Research, Vol 15, No 6, p 1435-1444, December 1979. 14 Fig, 4 Tab, 11 Ref.

Descriptors: *Watersheds(Basins), *Rainfall, *Runoff, *Model studies, Mathematical models, Hydraulic similitude, Geomorphology, Discharge(Water), Streamflow, Dynamic programming, Storms, Storm runoff, Drainage, Hydrographs, Unit hydrographs, Synthetic hydrology, Hydrology, Hydrologic similarity, Geomorphic structure, Hydrologic response.

It was shown that the dynamic parameter nu of the geomorphologic instantaneous unit hydrograph (IUH) can be taken as the velocity at the peak discharge time for a given rainfall-runoff event in a basin. This transforms the time variant IUH throughout the event into a time invariant IUH in each storm occurrence. The errors which the a priori estimation of the velocity in the IUH may cause in the calculation of the peak and time to peak of the runoff discharge were estimated for different types of basins and storms; the relative weights of the storm characteristics and the drainage network parameters in the prediction procedure were also studied in detail. Drainage basins were defined as hydrologically similar if they have the same IUH when kinematic conditions were kept the same; through the geomorphologic IUH theory it was shown that the controlling parameter in hydrologic similarity is (R sub L) to the 0.43 power/l sub omega. (Sims-ISWS)
W80-03957

A RAINFALL-RUNOFF ANALYSIS OF THE GEOMORPHOLOGIC IUH,
Universidad Simon Bolivar, Caracas (Venezuela).
J. B. Valdes, Y. Fiallo, and I. Rodriguez-Iturbe.
Water Resources Research, Vol 15, No 6, p 1421-1434, December 1979. 20 Fig, 1 Tab, 8 Ref.

Descriptors: *Watersheds(Basins), *Geomorphology, *Rainfall, *Runoff, *Model studies, *Puerto Rico, Mathematical models, Rainfall-runoff relationships, Hydrologic properties, Streamflow, Hydrographs, Unit hydrographs, Synthetic hydrology, On-site investigations, Hydrology, *Venezuela, Hydrologic response, Geomorphologic structure.

The instantaneous unit hydrograph (IUH) derived from the geomorphologic characteristics of a basin and a timing component, the velocity of the discharge, was presented by Rodriguez-Iturbe and Valdes. To analyze this geomorphologic IUH in real world basins, a study was carried out on several basins in Venezuela and Puerto Rico. The geomorphologic IUH for each basin was compared with the IUH's derived from the discharge hydrograph produced by a physically based rainfall-runoff model of the same basins. The effects that the nonlinearities of the rainfall-runoff model have on the derivation of the IUH were analyzed, and further, controlled experiments were carried out in which the IUH was derived under constant velocity conditions. The geomorphologic IUH's and the ones obtained in the experiments were remarkably similar in all the basins analyzed. (Sims-ISWS)
W80-03958

EFFECT OF PERIODIC PARAMETERS ON THE AUTOCORRELATION STRUCTURE OF HYDROLOGIC SERIES,
Technical Univ. of Istanbul (Turkey). Dept. of Hydraulic and Water Power.
For primary bibliographic entry see Field 2E.
W80-04039

THE WORTH OF HYDROLOGIC DATA,
Dames and Moore, Washington, DC.
For primary bibliographic entry see Field 7A.
W80-04043

THE WORTH OF HYDROLOGIC DATA FOR NONOPTIMAL DECISION MAKING,
Arizona Univ., Tucson. Dept. of Hydrology and Water Resources.
For primary bibliographic entry see Field 6B.
W80-04044

KRIGING IN THE DESIGN OF STREAMFLOW SAMPLING NETWORKS,
Institut National de la Recherche Scientifique, Rimouski (Quebec).
For primary bibliographic entry see Field 7A.
W80-04047

TERMINATION OF HYDROLOGIC DATA COLLECTION (A CASE STUDY),
Science and Education Administration, Tucson, AZ. Southwest Rangeland Watershed Research Center.
For primary bibliographic entry see Field 6B.
W80-04049

SIMULATED CHANGES IN GROUND-WATER LEVELS AND STREAMFLOW RESULTING FROM FUTURE DEVELOPMENT (1970 TO 2020) IN THE PLATTE RIVER BASIN, NEBRASKA,
Geological Survey, Lincoln, NE. Water Resources Div.
For primary bibliographic entry see Field 6A.
W80-04096

2B. Precipitation

RAINFALL MEASUREMENTS BY WEATHER RADAR: APPLICATIONS TO HYDROLOGY,
Research Council of Alberta, Edmonton. Atmospheric Science Div.
For primary bibliographic entry see Field 7B.
W80-03929

A STOCHASTIC DESCRIPTION OF WET AND DRY SPELLS IN TERMS OF AN EFFECTIVE NUMBER OF DAYS,
Royal Netherlands Meteorological Inst., De Bilt.
For primary bibliographic entry see Field 6A.
W80-03938

CONSIDERATIONS FOR THE DESIGN OF A HYDROLOGIC DATA NETWORK USING MULTIVARIATE SENSORS,
National Weather Service, Fort Worth, TX. Southern Region.
For primary bibliographic entry see Field 7A.
W80-03941

DENSE NETWORKS TO MEASURE CONVECTIVE RAINFALL IN THE SOUTHWESTERN UNITED STATES,
Science and Education Administration, Tucson, AZ. Southwest Rangeland Watershed Research Center.
For primary bibliographic entry see Field 7A.
W80-03943

MEASUREMENTS OF RAINFALL INTENSITY, INSTRUMENTATION AND DATA PROCESSING,
Forsvarets Forskningsanstalt FOA, Stockholm (Sweden).
S. Wickerts, and S. Granath.
FOA rapport C 30157-E2, E1, January 1979. 31 p, 27 Fig, 2 Ref.

Descriptors: *Climatic data, *Rainfall intensity, *Instrumentation, *Data storage and retrieval, Precipitation(Atmospheric), Measurement, Data processing, Rain gages, On-site tests, Data transmission, Automation, Sampling, Foreign research, Statistical methods, Calibrations, On-site data collections, Precipitation gages, *Sweden.

At the National Defense Research Institute (FOA), a system for measuring the rainfall intensity was developed. The measurements with the complete system started in June 1977, and the continued measurements are planned to go on at least until 1980. In this paper the equipment, including the data-collecting system, was described in the first part. The second part of the paper dealt with the data handling from recording over corrections and checks via multiplication with the calibration factors to a data base containing rainfall rate (mm/H) minutes by minutes during occasions with rain from all the 24 rain gages used in the test area. Also described was some of the statistical treatment done on the data from the above-mentioned data base. (Humphreys-ISWS)
W80-04028

NETWORK DESIGN USING OPTIMAL ESTIMATION PROCEDURES,

Institute of Hydrology, Wallingford (England).
For primary bibliographic entry see Field 7A.
W80-04045

A CASE STUDY OF RATIONALIZATION OF A RAIN GAGE NETWORK IN SOUTHWEST ENGLAND,
Institute of Hydrology, Wallingford (England).
P. E. O'Connell, R. J. Gurney, D. A. Jones, J. B. Miller, and C. A. Nicholass.
Water Resources Research, Vol 15, No 6, p 1813-1822, December 1979. 5 Fig, 6 Tab, 3 Ref.

Descriptors: *Precipitation(Atmospheric), *Rain gages, *Networks, Gages, Optimization, Areal, Estimating, Rainfall, Spatial distribution, *Rain gage networks, *Case study, *England, *Southwest England, Rationalization, Wessex Water Authority, Optimal estimation, Point rainfall, Areal rainfall, Interpolation.

Redesign of the Wessex Water Authority daily and monthly rain gage networks in southwest England was proposed, based on optimal estimation procedures. Accuracy requirements for point and areal rainfall estimates were assessed from a survey of the use of data from the existing network. Root mean square errors of interpolation were calculated for the existing networks of 333 daily gages and 379 monthly gages using estimates of the spatial autocorrelation of daily and monthly rainfall. Maps of the interpolation accuracy were drawn and compared with the accuracy required by users. The accuracies of areal estimates in certain areas were also assessed. Three network configurations were designed of 75, 220, and 297 daily gages. The 220-gage network was found to provide satisfactory accuracies for most users and was adopted for implementation. (Roberts-ISWS)
W80-04046

USE OF PRINCIPAL COMPONENT ANALYSIS TO IDENTIFY HOMOGENEOUS PRECIPITATION STATIONS FOR OPTIMAL INTERPOLATION,
Institut National de la Recherche Scientifique, Rimouski (Quebec).
For primary bibliographic entry see Field 7A.
W80-04048

2C. Snow, Ice, and Frost

CHELATION OF DIVALENT METAL IONS BY BROWN ALGAL POLYPHENOLS,
Trondheim Univ. (Norway). Inst. of Marine Biochemistry.
M. A. Ragan, O. Smidsrod, and B. Larsen.
Marine Chemistry, Vol 7, p 265-271, 1979. 1 Fig, 1 Tab, 28 Ref.

Descriptors: *Phaeophyta, *Biochemistry, *Chelation, *Metals, *Marine algae, *Polyphloroglucinols, Chemical reactions, Chemical properties, Phenols, Chemical analysis, Organic compounds, Manganese, Strontium, Magnesium, Calcium, Cadmium, Cobalt, Zinc, Nickel, Lead, Copper, Beryllium.

High-molecular-weight, nondialyzable polyphloroglucinols from the marine brown algae Ascophyllum nodosum and Fucus vesiculosus (Phaeophyceae, Fucales) chelate the divalent metal ions $Sr2(+)$, $Mg2(+)$, $Ca2(+)$, $Be2(+)$, $Mn2(+)$, $Cd2(+)$, $Co2(+)$, $Zn2(+)$, $Ni2(+)$, $Pb2(+)$ and $Cu2(+)$ in weakly acidic aqueous solution. Values of the relative selectivity coefficients k have been calculated relative to $Mn2(+)$; the ionotropic series with the algal polyphenols are similar to those with catechol and pyrogallol. These studies may serve as a guide for the examination of metal chelation by brown algal polyphenols both in situ and after exudation into seawater. (Deal-EIS)
W80-03987

2D. Evaporation and Transpiration

AN ENERGY BUDGET ANALYSIS OF WATER USE BY SALTCEDAR,
Arizona Univ., Tucson. School of Renewable Natural Resources.
L. W. Gay, and L. J. Fritschen.
Water Resources Research, Vol 15, No 6, p 1589-1592, December 1979. 2 Fig, 3 Tab, 6 Ref. OWRT C-6030(No 5235)(6).

Descriptors: *Water utilization, *Tamarisk, *Energy budget, *New Mexico, Evapotranspiration, Phreatophytes, On-site investigations, Arid lands, Energy transfer, Analytical techniques, Analysis, On-site tests, Lysimeters, Latent heat.

Bowen ratio estimates of evapotranspiration (ET) over a stand of saltcedar (Tamarix chinensis) on the Rio Grande floodplain in central New Mexico provide (1) estimates of water use by saltcedar during hot, dry weather, (2) comparisons of ET measured at two different locations within the same stand, and (3) comparison of ET over natural stands with results obtained from four constant-level lysimeters. The mean ET for 5 consecutive days (June 14-18, 1977) was 8.2 mm/d by the Bowen ratio and 7.9 mm/d by the lysimeters. Vegetation on the lysimeters and at the Bowen ratio sites differed in density and vigor in a manner consistent with the evapotranspiration measurements. Given these differences, the agreement between methods was judged excellent. The agreement also substantiates the usefulness of the mobile, although more tedious, energy budget method for estimating evapotranspiration from riparian sites in arid zones. (Humphreys-ISWS)
W80-04020

URBAN LAWN EVAPOTRANSPIRATION--MEASUREMENT AND PREDICTION,
Pool (Charles) and Associates, Inc., Ketchikan, AK.
P. O'Neill, L. Pochop, and J. Borrelli.
Transactions of the American Society of Agricultural Engineers, Vol 22, No 5, p 1050-1053, September-October 1979. 3 Fig, 3 Tab, 9 Ref. OWRT B-035-WYO(7), 14-34-0001-7201.

Descriptors: *Evapotranspiration, *Lawns, *Wyoming, Water rights, Lysimeters, Water users, Grasses, Evaporation, Consumptive use, *Urban lawn evapotranspiration, *Blaney-Criddle formula, Lawn grasses, Residential lawns, Lawn water requirements, Potential evapotranspiration, Lysimeter measurements.

A calibration of the Blaney-Criddle formula based on measurements of evapotranspiration rates directly from urban lawns was presented. Potential evapotranspiration rates were measured in Laramie and Wheatland, Wyoming, during the summers of 1976 and 1977. Measurements were taken using small weighable lysimeters located in lawns surrounding single family residences. The calibrated equations for the Criddle and others and the Soil Conservation Service methods provided improved estimates of evapotranspiration rates suitable for most engineering uses. The test locations represented a wide range of climatic conditions which allowed the calibrated equation to be used for bluegrass at other locations in the western United States. (Roberts-ISWS)
W80-04021

COMPREHENSIVE MONITORING OF METEOROLOGY, HYDRAULICS, AND THERMAL REGIME OF THE SAN DIEGO AQUEDUCT, CALIFORNIA,
Geological Survey, NSTL Station, MS. Water Resources Div.
H. E. Jobson, and A. M. Sturrock, Jr.
Available from Supt. of Documents, GPO, Washington, DC 20402, Price, $3.00. Geological Survey Professional Paper 1137, 1979. 29 p, 31 Fig, 6 Tab, 5 Ref.

Descriptors: *Energy budget, *Hydrologic cycle, *Aqueducts, *California, *Evaporation, Canals, Data collections, Methodology, Water temperature, Meteorological data, Wind velocity, Solar radiation, Vapor pressure, Flow rates, Evaluation, Forecasting, *San Diego aqueduct(Calif), Concrete-lined canal, Atmospheric radiation, Hydraulic variables.

Water temperature, as well as meteorologic and hydraulic variables which influence the energy budget of the San Diego Aqueduct in southern California, were continuously monitored for a 1-year period beginning July 24, 1973. Incoming solar and atmospheric radiation, windspeed and direction, water temperature, and wet- and dry-bulb air temperatures were recorded at 10-minute intervals at each end of the 26-kilometer concrete-lined canal, while flow-rates and stages were determined at hourly intervals for five locations. Although only daily averaged values are presented in this report, all information necessary for the use and interpretation of these data are presented. Windspeeds were minimum during the early morning hours and maximum during the late afternoon; however, they were variable spatially. On the other hand, incoming radiation and absolute vapor pressure varied little from point to point. (Kosco-USGS)
W80-04100

THERMAL MODELING OF FLOW IN THE SAN DIEGO AQUEDUCT, CALIFORNIA, AND ITS RELATION TO EVAPORATION,
Geological Survey, NSTL Station, MS. Water Resources Div.
H. E. Jobson.
Available from Supt. of Documents, GPO, Washington, DC 20402, Price, $2.75. Geological Survey Professional Paper 1122, 1980. 24 p, 21 Fig, 5 Tab, 21 Ref.

Descriptors: *Heat budget, *Model studies, *Canals, *Evaporation, *California, Energy budget, Aqueducts, Heat transfer, Hydrologic cycle, Computer models, Methodology, Data collections, Mass transfer, Water temperature, Air-water interface, Evaluation, Wind velocity, Meteorological data, Solar radiation, Vapor pressure, Flow rates, Monitoring, *San Diego Aqueduct, Concrete-lined canal, Atmospheric radiation, Hydraulic variables.

The thermal balance of the 26-kilometer long concrete-lined San Diego Aqueduct, a canal in southern California, was studied to determine the coefficients in a Dalton type evaporation formula. Meteorologic and hydraulic variables, as well as water temperature, were monitored continuously for a 1-year period. A thermal model was calibrated by use of data obtained during a 28-day period to determine the coefficients which best described the thermal balance of the canal. The coefficients applicable to the San Diego Aqueduct are similar to those commonly obtained from lake evaporation studies except that a greater evaporation at low windspeeds is indicated. The model was verified by use of data obtained during 113 days which did not include the calibration data. These data verified that the derived wind function realistically represents the canal evaporation. An annual evaporation of 2.08 meters was computed which is about 91 percent of the amount of water evaporated annually from nearby class A evaporation pans. (Kosco-USGS)
W80-04102

CONSUMPTIVE USE AND YIELDS OF CROPS IN NEW MEXICO,
New Mexico State Univ., Las Cruces. Dept. of Agricultural Engineering.
T. W. Sammis, E. G. Hanson, C. E. Barnes, H. D. Fuehring, and E. J. Gregory.
Available from the National Technical Information Service, Springfield, VA 22161 as PB80-160732, Price codes: A06 in paper copy, A01 in microfiche. New Mexico Water Resources Research Institute, New Mexico State University Report No 115, December 1979, 108 p, 21 Fig, 13 Tab, 21 Ref, 4 Append. OWRT B-054-NMEX(2), 14-34-0001-6100.

Descriptors: *Consumptive use, *Evapotranspiration, *Crop production, *Soil-water-plant relationships, *New Mexico, Measurement, Lysimeters, Evaporation pans, Irrigation, Alfalfa, Barley, Corn, Cotton, Rye, Grain sorghum, Bluegrass, Sudangrass, Crop production function, *Blaney Criddle equation.

Alfalfa, barley, bluegrass, corn, cotton, rye, grain sorghum, and sudangrass were grown at selected locations throughout the state of New Mexico. Lysimeters were installed in the center of the fields, and yields, monthly and yearly evapotranspiration rates, were measured in 1976 and 1977. In 1978, a sprinkler-line source was used to irrigate alfalfa and cotton in field plots for the measurement of yields and evapotranspiration. These data and data from other irrigation projects were used to derive crop-production functions for alfalfa, corn, cotton, and grain sorghum. Potential evapotranspiration (PET) was determined at each study area using the methods of Penman, Jensen-Haise, Van Bavel, Priestly-Taylor, net radiation, modified pan, and pan evaporation. These data were combined with the evapotranspiration measured in lysimeters to determine a monthly and yearly crop coefficient by each method used to compute PET. Measured seasonal evapotranspiration values are compared to those computed by these techniques. (Herman-NMex)
W80-04107

2E. Streamflow and Runoff

PERSISTENCE MODELING FOR THE POTOMAC AND ADJACENT RIVERS,
Washington Technical Inst., DC. Water Resources Research Center.
G. K. Young, and R. U. Jettmar.
Available from the National Technical Information Service, Springfield, VA 22161 as PB80-158280, Price codes: A03 in paper copy, A01 in microfiche. Report No 12, September 1977. 26 p, 7 Fig, 17 Ref. OWRT-B-008-DC(1).

Descriptors: *Mathematical models, *Persistence, *Flow characteristics, Low-flow frequency, Flow rates, Flow duration, Droughts, Low flow, Hydrologic budget, Water shortage, Monte Carlo method, Probability, Statistical models, Least squares method, Critical flow.

Case studies of three rivers are used to analyze a persistence modeling strategy for the generation of synthetic stream flows for drought assessment probabilities and confidence levels. The predominantly unregulated river sites used in the study are the Patuxent River near Unity, Maryland, the Potomac River at Point of Rocks, Maryland, and the Rappahannock River near Fredericksburg, Virginia. In an effort to improve the use of Monte Carlo models to produce drought characteristics from synthetic data, the strategy employed for the study uses least squares to fit theoretic autocorrelation functions to empiric functions. The model is designed to aid in critical period analysis in the designing of reservoirs to meet water requirements by solving the major problem of previous models, having an historic critical period or drought of greater severity than can be captured by the model. A key assumption of the modeling method used is that normalized monthly data are stationary. Flow analysis is discussed and illustrated with a chart. Two types of drought phenomena can be defined from the critical period analysis of historic streamflow, (1) short term drought (extreme low flow for six to eight months), and (2) long term drought (lower than historic yearly average flow for three to five years). Graphs of critical flows are given for the three cases studied. Results show that the least squares method produces lower errors, that all methods produce errors of about 10% or less for critical periods of over three years, and for short droughts all methods produced errors of over 10%. (Seigler-IPA)
W80-03916

STORM TRAVEL DISTANCE CALCULATIONS FOR TOTAL PHOSPHORUS AND SUSPENDED MATERIALS IN RIVERS,
West Virginia Univ., Morgantown. Dept. of Chemical Engineering.
For primary bibliographic entry see Field 5B.
W80-03930

DEVELOPMENT OF HYDROMETRIC NETWORKS IN BRITISH COLUMBIA,
Water Survey of Canada, Vancouver (British Columbia).
For primary bibliographic entry see Field 7A.
W80-03944

STABILIZED SAND SURFACES FOR OVERLAND FLOW STUDIES,
British Columbia Univ., Vancouver. Dept. of Bio-Resource Engineering.
T. H. Podmore, and J. R. Burney.
Water Resources Research, Vol 15, No 6, p 1647-1648, December 1979. 10 Ref.

Descriptors: *Surfaces, *Hydraulic models, *Overland flow, *Surface sealing, Coatings, Roughness(Hydraulic), Sands, Methodology, Plastics, Polymers, Stabilized sand surfaces.

A method was developed to produce stable durable sand surfaces for use in overland flow studies. Hydraulic and physical characteristics of the surfaces produced could be quantified repetitively without deterioration. Due to the inability to reject undesirable bed forms using Portland cement, polyester resins used for laminating fiberglass were tested. Both clear laminating and casting resins in solution with styrene monomer were used on test samples and on full size beds. The surfaces formed had a variety of channel forms and the appearance of natural wet sand. No deterioration was found following repeated hydraulic testing and measurement of physical surface characteristics. In addition, the beds were solid enough to walk on with some care and provided access to all points. Total time for formation of a surface was approximately 10 days including drying time. (Humphreys-ISWS)
W80-03945

IMPACT OF ROAD NETWORKS ON SOUTHEASTERN MICHIGAN LAKESHORE DRAINAGE,
Michigan Univ., Ann Arbor. Dept. of Geography.
E. N. Bannister.
Water Resources Research, Vol 15, No 6, p 1515-1520, December 1979. 5 Fig, 14 Ref.

Descriptors: *Streams, *Drainage, *Michigan, *Lake Michigan, Drainage density, Geomorphology, Lake shores, Sediment transport, Channels, Runoff, Drainage patterns(Geologic), Roads, *Road networks, Upland drainage.

The postglacial drainage of till plains and lake beds by perennial and intermittent streams in southeastern Michigan reveals local adjustments caused by human activity. The present drainage pattern reflects the construction and subsequent maintenance of the local road network. The impact of the road grid on the linear coastal drainage off the Port Huron Moraine's eastern flank was studied from Lexington Heights to Forester, Michigan. Borrow pits supplied the aggregate used to construct bridges and culverts. These facilities restrict flow and reduce transportation of sediment-laden runoff. This results in increased but localized sedimentation. The extension, maintenance, and use of road networks has artificially increased the drainage density of the region by creating additional avenues for surface flow. Road networks also truncate natural drainage channels, forcing the coalescence of the smaller order basins, thereby increasing downcutting and runoff in channels whose natural erosional development would have been much less. Channel reaches whose upland drainage has been pirated experience decreased runoff and exhibit less erosion. Such modern changes in drainage topology pose problems to the reconstruction of historical postglacial drainage patterns, since they result in greater stream drainage density. (Lee-ISWS)
W80-03951

DISCHARGE RESPONSE ANALYSIS AND HYDROLOGIC SIMILARITY: THE INTERRELATION BETWEEN THE GEOMORPHOLOGIC IUH AND THE STORM CHARACTERISTICS,
Universidad Simon Bolivar, Caracas (Venezuela).
For primary bibliographic entry see Field 2A.
W80-03957

A RAINFALL-RUNOFF ANALYSIS OF THE GEOMORPHOLOGIC IUH,
Universidad Simon Bolivar, Caracas (Venezuela).
For primary bibliographic entry see Field 2A.
W80-03958

CHELATION OF DIVALENT METAL IONS BY BROWN ALGAL POLYPHENOLS,
Trondheim Univ. (Norway). Inst. of Marine Biochemistry.
For primary bibliographic entry see Field 2C.
W80-03987

USE OF EXTREME VALUE THEORY IN ESTIMATING FLOOD PEAKS FROM MIXED POPULATIONS,
Utah Water Research Lab., Logan.
R. V. Canfield, D. R. Olsen, R. H. Hawkins, and T. L. Chen.
Available from the National Technical Information Service, Springfield, VA 22161 as PB80-161052, Price codes: A03 in paper copy, A01 in microfiche. Hydraulics and Hydrology Series UWRL/H-80/01, February 1980. 42 p, 29 Fig, 12 Tab, 8 Append. OWRT-B-173-UTAH(1), 14-34-0001-9100.

Descriptors: *Flood peaks, Flood frequency, Runoff, *Flood forecasting, *Peak discharge, Streamflow, Flood flow, Planning, flood control, Flood plain management, Extreme value theory, Mixed populations, Empirical goodness-of-fit, Fisher-Tippett function, Gumbel distribution, Log-Pearson type III distribution.

A number of extreme-value distributions are examined, and plotting tests are provided for selecting one particularly applicable to flow series composed of the largest flow from each year of record. The generally most appropriate was found to be not the Gumbel distribution, which assumes neither an upper nor a lower bound to the possible flood flows, but rather a form adding a third parameter as an upper bound to the flood flow. The existence of such an upper bound seems reasonable hydrologically, and a maximum likelihood fit of this distribution to 14 stations around the world with over 50 years of record compares favorably with that of the log-Pearson type III distribution. More efficient parameter estimating techniques are, however, needed. The plotting tests for many series were found to exhibit a break between two linear portions suggesting that the recorded flows may in fact be drawn from two or more populations. The form of a distribution of a series drawn as a mixture from two populations is shown theoretically to be multiplicative with respect to the two functions (rather than having the more commonly used additive form). A five parameter distribution was applied to 11 long-term sequences shown by the plotting test to originate from nonhomogeneous sources. The fit was generally excellent.
W80-04015

THE WORTH OF STREAMFLOW DATA IN WATER RESOURCES PLANNING: COMPUTATIONAL RESULTS,
Case Western Reserve Univ., Cleveland, OH.
Y. Y. Haimes, J. A. Craig, and J. Subrahmanian.
Water Resources Research, Vol 15, No 6, p 1335-1342, December 1979. 9 Fig, 11 Tab, 18 Ref, 1 Append. OWRT C-6027(No 5202)(2), 14-31-0001-5202.

Descriptors: *Streamflow, *Water resources, *Data collections, *Model studies, Mathematical models, Data processing, Costs, Planning, Water yield, Rivers, Hydrology, Synthetic hydrology, Methodology, Analytical techniques.

This paper presented computational results for evaluating the worth of streamflow data in water resources planning. Synthetic streamflow was generated with a synthetic streamflow generator, HEC-4 simulation model, where the optimal scheduling and capacity expansion of water supply projects were determined with a dynamic programing model. Penalty matrices associated with high- and low-yield estimates were then developed, using the results from the HEC-4 and the dynamic programing models. A multiobjective op-

timization problem was then formulated, minimizing the expected monetary penalty (in dollars) and the expected water shortage penalty (in million gallons). The solution of the multiobjective optimization problem (by using the surrogate worth trade-off (SWT) method) yielded a Pareto optimal and preferred data collection policy. (Sims-ISWS)
W80-04019

APPLICATION AND ANALYSIS OF A COUPLED SURFACE AND GROUNDWATER MODEL,
Montana State Univ., Bozeman. Dept. of Civil Engineering and Engineering Mechanics.
A. B. Cunningham, and P. J. Sinclair.
Journal of Hydrology, Vol 43, No 1/4, p 129-148, October 1979. 4 Fig, 4 Tab, 19 Ref. OWRT B-078-NEV(2).

Descriptors: *Streamflow, *Groundwater, *Nevada, *Model studies, Mathematical models, Equations, Channel flow, Streams, Rivers, Open channel flow, Water levels, Groundwater movement, Finite element analysis, Mathematics, Analytical techniques, Hydrology, *Truckee River(NV).

A model which couples two-dimensional, transient, saturated subsurface flow (Boussinesq equation) and one-dimensional, gradually-varied, unsteady, open-channel flow (Saint-Venant equations) was developed and applied to the Truckee River system in norhtern Nevada. The coupled model involved simultaneous numerical solution of the surface and subsurface flow equations using the Galerkin finite-element method. This paper attempted to address questions regarding the application of such a model to both real and hypothetical hydrologic systems in terms of analysis of parameter sensitivity, predictive uncertainty, and uniqueness of model solution. Investigation of parameter sensitivity provides information regarding the relative accuracy with which individual system parameters should be measured in order to insure successful model operation. Model predictive uncertainty was evaluated based on comparison of model output and field observations obtained over a two-year period from the Truckee River study area in northern Nevada. Results indicated fair to good prediction of both high and low river stage and groundwater table elevations with predictive accuracy decreasing with distance away from river channel. A procedure for quantifying uniqueness of model solution was developed to provide insight into the reliability associated with extrapolation of model output beyond the limits of observed field measurements. Based on results for the Truckee River system, such extrapolation appears to be justified. (Sims-ISWS)
W80-04024

EFFECT OF PERIODIC PARAMETERS ON THE AUTOCORRELATION STRUCTURE OF HYDROLOGIC SERIES,
Technical Univ. of Istanbul (Turkey). Dept. of Hydraulic and Water Power.
Z. Sen.
Water Resources Research, Vol 15, No 6, p 1639-1642, December 1979. 1 Fig, 1 Tab, 4 Ref.

Descriptors: *Correlation analysis, *Model studies, *Hydrology, Mathematical models, Time series analysis, Stochastic processes, Rainfall, Runoff, Flow, Streamflow, Evaporation, Analytical techniques, Autocorrelation, Periodic parameters.

The autocorrelation structure of a seasonal hydrologic series was analytically investigated, given a set of periodic parameters such as the means, standard deviations, and seasonal serial correlations between any two seasons. It was observed that periodic means have the most important effect on the correlogram of the seasonal data, whereas the periodicities in the standard deviations and seasonal serial correlations have minor effects which might easily be neglected in the practical hydrological studies of any water resources system design. (Sims-ISWS)
W80-04039

A STATISTICAL APPROACH TO STATION DISCONTINUANCE,
Princeton Univ., NJ. Dept. of Civil Engineering.
E. F. Wood.
Water Resources Research, Vol 15, No 6, p 1859-1866, December 1979. 9 Fig, 1 Tab, 9 Ref.

Descriptors: *Hydrologic data, *Sampling, *Value, *Decision making, Stations, Statistical methods, Hydrologic aspects, Network design, Probability, Analytical techniques, Floods, Data collections, Statistics, Streamflow, Costs, Variability, Discharge(Water), *Susquehanna River(PA), *Harrisburg(PA), Station discontinuance.

The sequential probability ratio test (SPRT) was developed and applied to the station discontinuance problem. The decision whether to discontinue a station is dependent upon statistical considerations that include the error probabilities of accepting a model when it is incorrect as well as rejecting it when it is correct. Both error probabilities can be explicitly set by using the SPRT approach so that the decision rules are: accept model 1, accept model 2, continue to sample (cannot accept either). The error probability levels are a decision variable that depends upon the use of the data and the cost of collection. Procedures were developed for determining the expected benefits from sampling one additional time within the SPRT framework. The SPRT approach was applied to the Susquehanna River at Harrisburg, Pennsylvania. The results of the analysis show that the Log-Pearson III distribution is statistically superior to three other competing models and that data collection could be ceased after 76 years. The analysis used a probability of error of 0.05. The paper also showed how the cost of sampling can be used in conjunction with SPRT to analyze station discontinuance. (Humphreys-ISWS)
W80-04050

ESTIMATION OF FLOODS OF VARIOUS FREQUENCIES FOR THE SMALL EPHEMERAL STREAMS IN EASTERN WASHINGTON,
Geological Survey, Tacoma, WA. Water Resources Div.
W. L. Haushild.
Geological Survey Water-Resources Investigations 79-81 (open-file report), 1979. 22 p, 6 Fig, 4 Tab, 11 Ref.

Descriptors: *Estimating, *Floods, *Frequency analysis, *Ephemeral streams, *Regional analysis, Analytical techniques, Data collections, Sites, Watersheds(Basins), Equations, Regression analysis, Estimating equations, Streamflow, Drainage area, Peak discharge, Flood forecasting, Flood recurrence interval, Precipitation(Atmospheric), *Eastern Washington.

Equations were developed to estimate the magnitude of floods for various occurrence frequencies at ungaged sites on ephemeral streams that drain small, relatively undeveloped basins in the semiarid part of eastern Washington. The equations were developed from regression analyses that used the logarithms of the longitude indexes of gaged sites, forest cover, and drainage areas of the upstream basins as independent variables and the logarithms of the discharges for selected exceedance-probabilities at the gaged sites were used as dependent variables. These equations may be used to estimate floodflows with probabilities of being exceeded in any year of 50, 20, 10, 4, 2, and 1 percent in natural-flow ephemeral streams that drain relatively undeveloped basins with areas and forest covers less than about 40 square miles and 30 percent, respectively. The standard errors of estimate for the equations range from 57 to 100 percent. Equations that use longitude index as a surrogate for a precipitation index more accurately estimate floods than do equations that use mean annual precipitation, which, in turn, are better than the equations that use the 24-hour precipitation with an exceedance probability of 50 percent. (Kosco-USGS)
W80-04093

STATISTICAL ANALYSIS OF NITRATE CONCENTRATIONS FROM THE RIVER FROME (DORSET) FOR THE PERIOD 1965-76,
Freshwater Biological Association, Wareham (England). River Lab.
For primary bibliographic entry see Field 5B.
W80-04101

FLOOD HAZARD STUDY -- BERKLEY CREEK AND TRIBUTARIES, HALL COUNTY, TEXAS.
Soil Conservation Service, Temple, TX.
Prepared in cooperation with the Hall-Childress Soil and Water Conservation District Hall County Commissioners Court, City of Memphis and the Texas Department of Water Resources, October 1979. 103 p, 43 Fig, 4 Tab, 12 Ref, 1 Append.

Descriptors: *Flood forecasting, *Texas, *Land use, *Flood data, Flood profiles, Flood peak, Flood frequency, Flood plain zoning, Flood protection, Mapping, Streamflow, Urbanization, Flood recurrence interval, Watersheds(Basins), Ranges.

Areas subject to flooding by Berkley Creek and its major tributaries were identified as a guide to aid in decisions concerning land use and future development in the Memphis, Texas, area. Berkley Creek, located in the northeast part of Hall County, has a total drainage area of 22.5 square miles or 14,400 acres at its confluence with Parker Creek. Average rainfall for the area is about 20.53 inches. Of the land in the watershed 7,214 acres are native rangeland, 5,765 acres are cropland, and 1.421 acres are urban. Involved in the hazard study are 5.5 miles of Berkley Creek, 4.5 miles of Parker Creek, and parts of four tributaries. Approximately 40% of the flood plain is used for agriculture with cotton being the major crop. Approximately 50% of the flood plain is rangeland mostly covered by short and mid grasses. There is some minor flooding every year with serious damage occurring about once every three to five years such as in 1950, 1954, 1955, 1956, 1960, 1973, 1975, 1978, and 1979. A flood in excess of a 500-year event occurred June 2, 1973. Aerial photographs are used to illustrate the limits of 100-year and 500-year frequency floods for the areas studied. Water surface profiles are used to show 10-year, 50-year, 100-year, and 500-year floods for the streams including stream elevation, channel bottom, and bridge and roadway data. Local recommendations and various flood plain management measures are discussed. (Seigler-IPA)
W80-04103

A QUANTITATIVE ANALYSIS OF STREAMFLOW: THE IMPORTANCE OF PRECIPITATION AND GEOMORPHIC FACTORS IN DETERMINING YIELDS FROM SMALL WATERSHEDS,
Idaho Univ., Moscow. Coll. of Letters and Science.
For primary bibliographic entry see Field 6A.
W80-04106

NUMERICAL ABUNDANCE AND BIOMASS OF BACTERIA, ALGAE AND MACROBENTHOS OF A LARGE NORTHERN RIVER, THE ATHABASCA,
Waterloo Univ. (Ontario). Dept. of Biology.
For primary bibliographic entry see Field 5C.
W80-04127

THE 1976-1977 CALIFORNIA DROUGHT--A REVIEW,
California State Dept. of Water Resources, Sacramento.
May 1978. 228 p, 39 Fig, 11 Tab, 58 Illus, 83 Ref, 8 Append.

Descriptors: *Water resources, *Droughts, *Water shortage, *Water storage, *California, *Water supply, Water management(Administrative), Water demand, Hydrologic budget, Rationing(Water), Social aspects, Average runoff, Reservoir storage, Irrigation, Water utilization, Agriculture, Groundwater utilization, Legislation, Water conservation.

This report outlines the serious 1976-1977 drought in California, and includes a description of state and other program responses to the emergency. In

the 1976 water year annual precipitation was only 65% of average. In the 1977 water year, precipitation was even less--45% of average. Runoff to major streams and rivers was reduced to 47% and 22% for 1976 and 1977, respectively. Water storage in major reservoirs dropped during 1976 and 1977, with water storage in 143 major reservoirs dropping to 37% of the average for October 1, 1977, with some reservoirs dropping to as low as 5% of the 10-year average. All 13 state hydrologic regions were affected. Ground water use increased greatly during the period. The responses to the drought included emergency U.S. Department of Interior aid in order to augment community water supplies, to assist in water purchase and transport, and to promote conservation. Further aid came from U.S. Economic Development Administration and the Small Business Administration to aid especially water-dependent small businesses. The California Department of Water Resources established a drought information center, pilot conservation program, emergency loans, and special technical assistance to local governments. During 1978, most reservoirs recovered to normal or near normal stages. Urban area conservation programs are now in effect and are expected to meet future drought emergencies more effectively than did past programs. (Arnold-NC)
W80-04189

2F. Groundwater

GROUNDWATER BASIN MODELING USING THE FINITE ELEMENT METHOD - YOLO COUNTY CASE STUDY,
California Univ., Davis, Dept. of Agricultural Economics.
For primary bibliographic entry see Field 6A.
W80-03904

MATHEMATICAL MODELLING OF GROUND-WATER FLOW,
G. Kovacs.
Vituki, 1978. 92 p, 31 Fig, 2 Tab, 44 Ref. Published by the Research Centre for Water Resources Development, Budapest (Hungary). Haszpra, O., editor.

Descriptors: *Mathematical models, *Groundwater movement, *Flow, *Porous media, *Hydraulic structures, Analytical techniques, Earth dams, Seepage, Flow characteristics, Model studies, Equations, Mathematics, Potential flow, Flow nets, Finite element analysis, Numerical analysis, Saturated flow, Unsaturated flow, Drawdown, Water table, Aquifers, Piezometry.

The practical problems of seepage to be solved in connection with the design and operation of hydraulic structures (dams, canals, wells, etc.) require the knowledge of the main hydraulic parameters of the water movement developing through the porous medium as a result of pressure difference prevailing between two points or section of the latter. The broad subject areas presented included: (1) general principles concerning the application of mathematical models and numerical methods to kinematic relationships characterizing seepage, and geometrical and kinematic classification of seepage; (2) solution of movement equations with numerical methods for boundary and initial conditions through porous media; (3) practical application of numerical methods for determination of flow nets in the cases of two-dimensional seepage, estimation of the influence of exploitation on groundwater regime, and investigation of multilayered aquifer systems. (Humphreys-ISWS)
W80-03927

STOCHASTIC ANALYSIS OF MACRODISPERSION IN A STRATIFIED AQUIFER,
New Mexico Inst. of Mining and Technology, Socorro.
L. W. Gelhar, A. L. Gutjahr, and R. L. Naff.
Water Resources Research, Vol 15, No 6, p 1387-1397, December 1979. 9 Fig, 38 Ref, 4 Append.

Descriptors: *Aquifers, *Groundwater, *Dispersion, *Model studies, Mathematical models, Stochastic processes, Hydraulic conductivity, Stratification, Groundwater movement, Statistics, Statistical models, Mass transfer, Flow, Hydrology, Macrodispersion, Stratified aquifer.

The longitudinal dispersion produced as a result of vertical variations of hydraulic conductivity in a stratified aquifer was analyzed by treating the variability of conductivity and concentration as homogeneous stochastic processes. The mass transport process was described using a first-order approximation which is analogous to that of G.I. Taylor for flow in tubes. The resulting stochastic differential equation describing the concentration field was solved using spectral representations. The results of the analysis demonstrated that for large time the longitudinal dispersivity approaches a constant value which is dependent on statistical properties of the medium. The analysis also described the transient development of the dispersive process and some non-Fickian effects which occur early in the displacement process. (Sims-ISWS)
W80-03928

A PLANNING MODEL FOR THE MANAGEMENT OF GROUNDWATER QUALITY,
Humboldt State Univ., Arcata, CA. Dept. of Environmental Resources Engineering.
R. Willis.
Water Resources Research, Vol 15, No 6, p 1305-1312, December 1979. 2 Fig, 7 Tab, 19 Ref.

Descriptors: *Groundwater, *Water quality, *Management, *Model studies, Mathematical models, Pumping, Injection, Injection wells, Waste disposal wells, Water wells, Hydraulic conductivity, Storage, Aquifers, Finite element analysis, Hydrology.

A dynamic planning model is presented for the optimal management of groundwater quality in regional aquifer systems. The groundwater system was conjunctively managed as a water supply resource and as a storage reservoir for wastewater residuals. The waste-waters were discharged to the groundwater basin through injection wells. Within the groundwater system, constituents were assumed to follow first-order chemical or biochemical reactions and linear equilibrium adsorption. The Galerkin finite element method was used to transform the flow and mass transport equations of the aquifer system into systems of ordinary differential equations which were imbedded as constraint equations in the planning model. The mathematical model, which was structured as a nonconvex programing problem, allows the planner or resource manager to determine (1) the optimal pumping and injection schedules (rates and locations) required to satisfy an exogenous water target and waste load demand and (2) the maximum injection concentrations that can be discharged to the basin without degrading the quality of the aquifer. Operational policies were developed for a 480-day operational cycle for a hypothetical groundwater basin, where it was assumed that groundwater extraction represents the principal resource of the aquifer system. Linear programing was used to identify the optimal planning policies. The important parameters affecting the optimal decisions were discussed. (Sims-ISWS)
W80-03932

DETERMINATION OF RECHARGE RATES USING TEMPERATURE-DEPTH PROFILES IN WELLS,
Environmental Protection Agency, Chicago, IL. Region V.
J. M. Boyle, and Z. A. Saleem.
Water Resources Research, Vol 15, No 6, p 1616-1622, December 1979. 7 Fig, 2 Tab, 38 Ref.

Descriptors: *Groundwater recharge, *Aquifers, *Illinois, *Hydrogeology, *Mathematical models, Recharge, Porous media, Dolomite, Analytical techniques, Analysis, On-site investigations, Water temperature, Heat transfer, Soil temperature, Groundwater movement, Profiles, Leakage, Infiltration, Natural recharge.

Recharge rates to the shallow dolomite aquifer in northeastern Illinois were determined using a theory which describes the simultaneous transfer of heat and fluid in a porous medium. Temperature-depth profiles in a nonpumping well are used to determine vertical groundwater velocities of the downward leakage of water recharging the aquifer which is overlain by semiconfining beds of clay-rich glacial drift. Calculated and observed depths of penetration (19 m) of the annual surface temperature wave, and demonstration of the thermal stability of the well, validate application of the theory, which uses a dimensionless parameter beta to relate curvature in temperature-depth profiles to the magnitude of vertical leakage. Generally, the magnitude of beta decreases as the depth interval L within the aquitard increases. The corresponding decrease in the vertical component of groundwater velocity accompanies a gradual coarsening with depth of the aquitard materials. Temperature differences over time at a given depth within a thermally stable well are found to be within the accuracy of the temperature measuring system. Analysis of variations in beta over time shows that the variability can be due to the limitations of the resolution (0.01C) of the temperature measuring system. Recharge rates determined by analysis of temperature-depth profiles range from 2.47 x 10 to the minus 9th power to 9.86 x 10 to the minus 9th power m/s and agree with estimates resulting from water-budget method. (Humphreys-ISWS)
W80-03946

SOIL SPATIAL VARIABILITY AND ITS CONSEQUENCES ON SIMULATED WATER BALANCE,
Commonwealth Scientific and Industrial Research Organization, Wembley (Australia). Div. of Land Resources Management.
For primary bibliographic entry see Field 2G.
W80-03947

STOCHASTIC ANALYSIS OF STEADY STATE GROUNDWATER FLOW IN A BOUNDED DOMAIN, 2. TWO-DIMENSIONAL SIMULATIONS,
Utah Univ., Salt Lake City. Dept. of Geology and Geophysics.
L. Smith, and R. A. Freeze.
Water Resources Research, Vol 15, No 6, p 1543-1559, December 1979. 14 Fig, 1 Tab, 23 Ref.

Descriptors: *Groundwater, *Groundwater movement, *Stochastic processes, *Model studies, Mathematical models, Hydraulic conductivity, Flow, Aquifers, Boundary processes, Pressure, Hydrology, Analytical techniques, Hydraulic head.

A stochastic analysis of two-dimensional steady state groundwater flow in a bounded domain was carried out by using Monte Carlo techniques. The flow domain was divided into a set of square blocks. A nearest-neighbor stochastic process model was used to generate a multilateral spatial dependence between hydraulic conductivity values in the block system. Both statistically isotropic and statistically anisotropic autocorrelation functions were considered. This model lead to a realistic representation of the spatial variations in hydraulic conductivity in a discrete block medium. Results of the simulations provided estimates of the output distributions in hydraulic head. The probability distribution for hydraulic head must be interpreted in terms of the spatial variation of the expected head gradients, the standard deviation in the hydraulic conductivity distribution, the ratio of the integral scales of the autocorrelation function for conductivity to the distance between boundaries on the flow domain, and the arrangement of statistically homogeneous units within the flow domain. The standard deviation in hydraulic head increases with an increase in either the standard deviation in hydraulic conductivity or the strength of the correlation between neighboring conductivity values. The standard deviations in hydraulic head are approximately halved when a uniform, bounded, two-dimensional flow field is reduced to one-dimensional form. The uncertainties in the predicted hydraulic head values are strongly influenced by the presence of a spatial trend in the mean hydraulic conductivity. In evaluating the concept of an effective conductivity for a heterogeneous medium, both the nature of the spatial heterogene-

ities in hydraulic conductivity and the flow system operating within the flow domain must be considered. (Sims-ISWS)
W80-03949

EFFECT OF INFILTRATION RATE ON BIOLOGICAL CLOGGING AND WATER QUALITY CHANGES DURING ARTIFICIAL RECHARGE,
Tohoku Univ., Sendai (Japan). Dept. of Civil Engineering.
For primary bibliographic entry see Field 4B.
W80-03950

THERMAL ENERGY STORAGE IN A CONFINED AQUIFER: EXPERIMENTAL RESULTS,
Auburn Univ., AL. Dept. of Civil Engineering.
F. J. Molz, A. D. Parr, P. F. Andersen, V. D. Lucido, and J. C. Warman.
Water Resources Research, Vol 15, No 6, p 1509-1514, December 1979. 12 Fig, 1 Tab, 17 Ref.

Descriptors: *Storage, *Thermal water, *Aquifers, *Groundwater, Hydraulic conductivity, Injection wells, Observation wells, Temperature, Water temperature, Energy, Pumping, Clogging, On-site investigations, Hydrology, Thermal energy storage.

To aid in testing the idea of storing thermal energy in aquifers, an experiment was performed by Auburn University in which 54,784 cu m of water were pumped from a shallow supply aquifer, heated to an average temperature of 55C, and injected into a deeper confined aquifer where the ambient temperature was 20C. After a storage period of 51 days, 55,345 cu m of water were produced from the confined aquifer. Throughout the experiment, which lasted approximately 6 months, groundwater temperatures were recorded at 6 depths in each of 10 observation wells, and hydraulic heads were recorded in 5 observation wells. In order to prevent errors due to thermal convection, most of the observation wells recording temperature had to be backfilled with sand. During the 41-day production period, the temperature of the produced water varied from 55 to 33C, and 65% of the injected thermal energy was recovered. At no time was an appreciable amount of free thermal convection observed in the storage formation. The dominant heat dissipation mechanisms appeared to be hydrodynamic thermal dispersion and possible mixing of cold and hot water induced by clogging and unclogging of the injection-production well. On the basis of laboratory and field studies, it was concluded that clogging of the injection well, which constituted the major technical problem during the experiment, was caused by the freshwater-sensitive nature of the storage aquifer. Due to the relatively low concentration of cations in the supply water, clay particles would swell disperse, and migrate until they became trapped in the relatively small pores connecting the larger pores. Surging the pump and back washing the injection well would dislodge the clogging particles and temporarily improve the storage formation permeability. (Sims-ISWS)
W80-03952

MODELING GROUNDWATER FLOW FIELDS CONTAINING POINT SINGULARITIES: STREAMLINES, TRAVEL TIMES, AND BREAKTHROUGH CURVES,
Stanford Univ., CA. Dept. of Civil Engineering.
R. J. Charbeneau, and R. L. Street.
Water Resources Research, Vol 15, No 6, p 1445-1450, December 1979. 5 Fig, 16 Ref. EPA-R-804431.

Descriptors: *Mathematical models, *Groundwater movement, *Travel time, Equations, Hydraulic properties, Wells, Velocity, Water pollution, Numerical analysis, Artificial recharge, Injection wells, *Streamlines, *Point singularities, *Breakthrough curves, *Transport models, Hydraulic head.

In the work of Charbeneau and Street (1979) a method was presented for modeling steady state groundwater flow fields containing injection and extraction wells. The Galerkin finite element method was used with greatly improved accuracy of the simulation near wells achieved by removing the singular behavior of the flow with an analytic solution for the near-well zone, solving the nonsingular problem, and combining the results. In this paper, methods for exploiting the improved hydraulic head solution were presented. Velocity fields are derived through differentiation of the head solution combined with smoothing and averaging. The velocity fields are used for generating systems of streamlines and determining times of travel to points of interest (including breakthrough curves for a nondispersive contaminant). The method was compared with analytical results for a single injection-extraction well pair. (See also W80-00609) (Visocky-ISWS)
W80-03956

REGIONAL IDENTIFICATION OF SALINE-SEEP RECHARGE AREAS, STILLWATER AND YELLOWSTONE COUNTIES, MONTANA,
Montana State Univ., Bozeman. Dept. of Earth Sciences.
S. G. Custer.
Available from the National Technical Information Service, Springfield, VA 22161 as PB80-159684, Price codes: A04 in paper copy, A01 in microfiche. Montana Water Resources Research Center, Montana State University Publication No 102, November 1979, 58 p, 9 Fig, 5 Tab, 29 Ref. OWRT A-111-MONT(1), 14-34-0001-9028.

Descriptors: *Saline water, *Groundwater recharge, *Recharge ponds, Soil water movement, Seepage, Land management, Hydrology, Marsh plants, Forage grasses, Specific conductance. *Saline seep, *Recharge area, *Natural recharge, Northern Great Plains, Montana, Stillwater County(Mont), Recharge area identification, *Geologic mapping.

Saline seep causes lost grain production, impassable roads, flooded basements, and stock deaths throughout the Northern Great Plains. The problem can be reduced by flexible cropping in the groundwater recharge area. The recharge area for each saline seep can be identified most efficiently on a regional scale. Saline seep recharge areas were identified in a 600 sq. mi. area in Stillwater and Yellowstone counties, Montana. The area was examined for regional soil and geologic factors which might control the problem. The principal control is the presence of a large internally-drained basin. The surface-water drainage basin contributing to each saline seep coincides with the recharge area for that seep. This relationship exists because the groundwater flow system is shallow and controlled by local topography. Problem areas were clarified by visual observation of plant communities and surface salt; and study of the specific electrical conductance of the water and soil. Communication of the results to the farmers in the area is an important part of the problem solution. The farmers locate themselves using cultural features. The 1:24,000 orthopotograph map base shows the cultural features clearly. The final recharge-area-map overlay includes farmstead names so that the farmer can locate himself easily.
W80-03959

GEOPHYSICAL AND HYDROLOGIC PREDICTION OF FISSURING AND LAND SUBSIDENCE, SOUTH-CENTRAL ARIZONA,
Arizona Univ. Tucson. Dept. of Geosciences.
J. S. Summer, and F. J. Christie.
Available from the National Technical Information Service, Springfield, VA 22161 as PB80-159908, Price codes: A02 in paper copy, A01 in microfiche. Water Resources Research Center, University of Arizona. Partial Project Completion Report, March 1980. 5 p. OWRT A-073-ARIZ(3), 14-34-0001-7005, 7006 and 8003.

Descriptors: *Land subsidence, *Fissures(Geologic), *Forecasting, Model studies, Geohydrologic units, Bedrock, Arizona, *Gravity exploration, Alluvial basins.

This research was directed toward the understanding of land subsidence, particularly as associated with the occurrence of earth fissures, as found in alluvial basins. The gravity exploration method was employed to survey the Picacho basin area in south-central Arizona where numerous fissures are located and where the land has subsided in excess of 12.5 feet (3.96 m) since 1952. A differential subsidence concept would predict that vertical offset fissures would most likely occur over basement irregularities. Therefore, the gravity data were interpreted in terms of the probable variation in thickness of alluvium overlying the more dense bedrock. Modeling of the bedrock surface under the basin area reveals a strong correlation between gravity gradients and earth fissures. Of earth fissures peripheral to the Picacho basin, 83 percent were correlated to lie with + or - 1/2 mile of a modeled bedrock surface irregularity. Thus it can be concluded that most vertical offset earth fissures are related to bedrock irregularities, and that the gravity method holds promise in predicting the probable occurrence of these features. (See also W79-02599)
W80-04013

CONSIDERATION OF TOTAL ENERGY LOSS IN THEORY OF FLOW TO WELLS,
Nevada Univ. System, Reno. Water Resources Center.
R. L. Cooley, and A. B. Cunningham.
Journal of Hydrology, Vol 43, No 1/4, p 161-184, October 1979. 7 Fig, 1 Tab, 18 Ref, 1 Append. OWRT A-061-NEV(2), 14-31-0001-5028.

Descriptors: *Groundwater, *Water wells, *Model studies, Mathematical models, Groundwater movement, Drawdown, Pumping, Porous media, Aquifers, Aquitards, Equations, Finite element analysis, Hydraulic conductivity, Hydrology.

A coupled numerical solution was developed for unsteady flow in single or multiple confined or semiconfined aquifers and in the well penetrating the system. Analysis of hypothetical problems indicated that, because of friction losses and nonuniform flow in the well bore, a significant region of nonradial flow in the aquifer(s) results whenever aquifer hydraulic conductivity is greater than about 0.015 m/min and pumping rate is greater than about 1.2 cu m/min. Because of this nonradial flow, use of standard aquifer testing equations can lead to significant errors in computed aquifer transmissivity whenever aquifer hydraulic conductivity is greater than about 0.03 m/min. Because of unsteady flow in the well bore, flow may be highly nonradial for the first few seconds of pumping irrespective of hydraulic conductivity or pumping rate. Percentage of open area in the screened or perforated section of well bore, Fanning friction factor, and contraction coefficients characterizing flow through the perforations or slots are parameters that could cause large head losses in the well in some cases. Expressions for parameters B and C in the total drawdown equation s sub w = BQ + CQ to the 2 power (where s sub w is drawdown in the well and Q is pumping rate) were developed dimensionally from expressions used in this study. The development shows that both B and C could theoretically be dependent on Q. (Sims-ISWS)
W80-04022

APPLICATION AND ANALYSIS OF A COUPLED SURFACE AND GROUNDWATER MODEL,
Montana State Univ., Bozeman. Dept. of Civil Engineering and Engineering Mechanics.
For primary bibliographic entry see Field 2E.
W80-04024

DUMANLI SPRING, TURKEY--THE LARGEST KARSTIC SPRING IN THE WORLD,
J. Karanjac, and G. Gunay.
Journal of Hydrology, Vol 45, No 3/4, p 219-231, February 1980. 5 Fig, 4 Ref.

Descriptors: *Springs, *Discharge(Water), *River flow, *Fluorescent dye, *Rhodamine, Tracers, Reservoir sites, Pre-impoundment, Karst, Base flow, Recession curves, Hydrographs, Limestones, Submergence, Aquifers, *Turkey.

The enormous Dumanli spring in the Mediterranean region of Turkey will be submerged by the

year 1982 by about 120 m head produced by the Oymapinar Reservoir. The spring contributes one-third to the annual discharge of the Manavgat River, which will be dammed at Oymapinar. The mean discharge of the spring is estimated at about 50 cu m/s; thus its total annual outflow is about 1.6 x 10 to the 9th power cu m. In October 1978 the authors measured the spring discharge by the dye-dilution technique. The flow rate of about 35.6 cu m/s at the very end of the dry period (at the end of the spring's discharge recession) motivated the authors to declare the Dumanli the largest karstic spring in the world, issuing from one single orifice. The results of the dye-dilution technique applied in this experiment were compared with staff-gage readings upstream and downstream of the Dumanli spring. To the best of the authors' knowledge this is the first reported dye-dilution experiment that accurately measured the discharge of a river with an annual flow of about 50 cu m/s. (Visocky-ISWS)
W80-04029

WATER RESOURCES OF THE LOWER ELWHA INDIAN RESERVATION, WASHINGTON,
Geological Survey, Tacoma, WA. Water Resources Div.
K. L. Walters, W. L. Haushild, and L. M. Nelson.
Geological Survey Water-Resources Investigations 79-82 (open-file report), 1979. 54 p, 14 Fig, 6 Tab, 12 Ref.

Descriptors: *Groundwater resources, *Indian reservations, *Available water, *Potential water supply, Fish hatcheries, Hydrogeology, Data collections, Sites, Climatic data, Hydrologic data, Hydrologic cycle, Water wells, Logging(Recording), Water-level fluctuations, Aquifers, Flow characteristics, Water quality, Surface waters, Groundwater, Flooding, Water temperature, Washington, *Lower Elwha Indian Reservation(Wash), Clallam County(Wash), Elwha River(Wash).

The Lower Elwha Indian Reservation covers 372 acres at the mouth of the Elwha River in Clallam County, Washington. The land of the reservation is used principally for residential purposes and growing forage for cattle. The population of the reservation is largely dependent upon fisheries resources for its economic health. This study was made to assess the availability and suitability of ground water on the reservation for domestic use and for fish propagation, to determine the streamflow characteristics of the Elwha River and Bosco Creek, and to determine the chemical and physical quality of the area's surface and ground waters. Existing wells on the reservation range in depth from about 30 to about 80 feet, and produce water of excellent chemical quality. Properly constructed wells in favorable locations on the reservation should be capable of large yields up to 5,000 gallons per minute. Intrusion of seawater into the aquifers of the reservation has not occurred. However, if massive quantities of ground water are withdrawn, intrusion could occur. The Elwha River, which flows along the western margin of the reservation has a mean annual flow of about 1,500 cubic feet per second (cu ft/s). The recorded minimum daily discharge was 10 cu ft/s, and the maximum was 41,600 cu ft/s. The river floods the lower parts of the reservation annually, and extensive flooding is common. Water in the Elwha River is of excellent chemical quality, and its recorded temperature has ranged from 36F to 64F. Bosco Creek, the only other stream on or adjacent to the reservation, has an estimated mean annual flow of 1.1 cu ft/s. (Kosco-USGS)
W80-04086

GROUND-WATER RESOURCES IN THE METROPOLITAN REGION OF NASHVILLE, TENNESSEE,
Geological Survey, Nashville, TN. Water Resources Div.
D. R. Rima, and P. L. Goddard.
Geological Survey report, 1979. 44 p, 6 Fig, 2 Plates, 6 Tab, 16 Ref. (Prepared in cooperation with U.S. Army Corps of Engineers, Nashville District).

Descriptors: *Groundwater resources, *Tennessee, *Groundwater availability, *Water resources development, *Water quality, Geomorphology, Hydrologic cycle, Hydrologic data, Water wells, Water analysis, Water yield, Aquifer characteristics, Limestones, Bedrock, Karst, Regolith, Subsurface flow, *North-central Tennessee, *Nashville(Tenn).

The availability of ground-water in a 10-county area in north-central Tennessee surrounding Nashville is reported. The Central Basin and Highland Rim physiographic regions equally comprise the study area. Records of wells and springs were analyzed to derive relationships between the availability of large ground-water supplies and maps depicting geologic and topographic features. In the Central Basin, significant features include the following: (1) depressions in bedrock structure; (2) low, flat areas; and (3) delineations of tops of four major aquifers. Significant features in the Highland Rim include the following: (1) regolith at least 60 feet thick; (2) depressions in bedrock structure; and (3) low, flat areas. The significant features in each region were used to prepare maps delineating areas of high, moderate, and low potential for the development of ground-water supplies. Large groundwater supplies are available in most of the study area. Yields of successful wells may range from 100 to 250 gallons per minute. (Kosco-USGS)
W80-04089

HYDROLOGIC DATA FROM SELECTED WELLS IN THE HELENA VALLEY, LEWIS AND CLARK COUNTY, MONTANA,
Geological Survey, Helena, MT. Water Resources Div.
J. A. Moreland, R. B. Leonard, T. E. Reed, R. O. Clausen, and W. A. Wood.
Geological Survey open-file report 79-1676, November 1979. 54 p, 18 Fig, 1 Plate, 4 Tab.

Descriptors: *Hydrologic data, *Water wells, *Montana, *Data collections, *Groundwater, Aquifer testing, Test wells, Drawdown, Pumping, Observation wells, Water level fluctuations, Measurement, Water quality, Water analysis, Water temperature, Chemical analysis, Irrigation, Maps, *Helena Valley(Mont), *Lewis and Clark County(Mont).

Hydrologic data were collected during 1978-79 to aid in evaluating the hydrologic conditions in shallow aquifers beneath the Helena Valley, Montana. The locations of 52 shallow test wells augered during the study are shown on a map at a scale of 1:48,000. Periodic water-level measurements and water-quality analyses for the test holes are listed in tables. Water temperature, specific conductance, and nitrate concentration are given for water samples collected from 98 domestic wells, and chemical analyses are included for 11 domestic and irrigation wells. In addition, water-level drawdown and recovery data are plotted on graphs for five pumped wells and three observation wells. (Kosco-USGS)
W80-04090

GROUNDWATER IN THE UNITED STATES 1975-78,
Geological Survey, Lawrence, KS. Water Resources Div.
J. S. Rosenshein.
Review of Geophysics and Space Physics, Vol 17, No 6, p 1240-1253, September 1979. 354 Ref.

Descriptors: *Groundwater, *United States, *Water resources development, *Water quality, *Groundwater resources, Aquifer systems, Droughts, Evaluation, Surface waters, Conjunctive use, Saline water intrusion, Waste disposal, Water management(Applied), Pumping, Subsidence, Chemical analysis, Reclaimed water.

Interest in groundwater has been at a high level from 1975 to 1978. The study of environmental problems caused greater interest in the relation of groundwater to energy and resources development, water-quality surveillance, and the legal and economic significance of depleting aquifer systems during extended droughts. Increased interest has been shown by creation and implementation of the National Water Data Exchange, the Safe Drinking Water Act requirements, summary appraisals of groundwater regions, Regional Aquifer-System Analyses, State-Federal Water Use Data Base, and numerous water-management districts. Research in groundwater systems included quantitative and qualitative evaluation for planning and management, conjunctive use of ground and surface water, land- and water-use management, contamination by saltwater and waste disposal, subsidence related to pumping or dissolution of salt beds, and the chemical and biochemical effects of reclaiming waste water. Analytical models were used to solve problems in two- and three-dimensional flow, confined and unconfined systems, transient and steady-state conditions, saturated and unsaturated flow, and estimation of aquifer parameters. (Kosco-USGS)
W80-04094

GEOLOGY AND GROUNDWATER RESOURCES OF MONROE COUNTY, PENNSYLVANIA,
Geological Survey, Harrisburg, PA. Water Resources Div.
L. D. Carswell, and O. B. Lloyd, Jr.
Pennsylvania Geological Survey, Fourth Series, Water Resources Report 47, 1979. 61 p, 7 Fig, 1 Plate, 12 Tab, 46 Ref, Append.

Descriptors: *Groundwater resources, *Hydrogeology, *Aquifer characteristics, *Groundwater availability, *Water quality, Water wells, Water yield, Water level fluctuations, Pumping, Surface-groundwater relationships, Groundwater recharge, Water analysis, Chemical analysis, Pennsylvania, *Monroe County(PA).

Monroe County is on the eastern border of Pennsylvania, where average annual recharge to and discharge from the ground-water reservoir is about 17 inches. Recharge circulates to a depth of more than 800 feet, but 85 percent of the circulation in above 400 feet. Glacial deposits and the underlying clastic and carbonate rocks comprise the groundwater reservoir, which stores about one trillion gallons of freshwater. One of every four wells located, constructed, and developed for large yields can, on the average, produce 400 gal/min from coarse glacial deposits; more than 200 gal/min from the Bloomsburg Formation, Poplar Gap Member of the Catskill Formation, and the carbonates; about 100 gal/min or more from the noncarbonates of the Silurian-Devonian undivided unit, the Marcellus, and the Trimmers Rock Formations; and less than 100 gal/min from the Mahantango Formation and the other members of the Catskill Formation. (Kosco-USGS)
W80-04095

GEOHYDROLOGIC DATA FOR THE BEAVER-PASQUISET GROUND-WATER RESERVOIR, RHODE ISLAND,
Geological Survey, Providence, RI. Water Resources Div.
For primary bibliographic entry see Field 7C.
W80-04098

ANALYSIS OF CHANGES IN GROUNDWATER LEVELS IN A SEWERED AND AN UNSEWERED AREA OF NASSAU COUNTY, LONG ISLAND, NEW YORK,
Geological Survey, Syosset, NY. Water Resources Div.
D. J. Sulam.
Ground Water, Vol 17, No 5, p 446-455, September-October 1979. 7 Fig, 4 Tab, 10 Ref.

Descriptors: *Mass curves, *Groundwater, *Water level fluctuations, *Sewerage, *New York, Drawdown, Pumping, Sewers, Cesspools, Septic tanks, Groundwater movement, Hydrographs, *Long Island(NY), Water level declines.

From the 1950's to the early 1970's, expansion of sanitary sewerage in southwest Nassau County, Long Island, N.Y., contributed to progressive declines in ground-water levels. Since the early 1970's however, 10 years after the area was fully

sewered, water levels have not declined significantly, which suggests that the water table may have reached a new equilibrium position. Double-mass-curve analyses show that during 1953-76 the average weighted ground-water levels in a 32-square-mile part of the sewered area declined 12.2 feet more than those in the unsewered area to the east. However, by 1973 this decline was 13.5 feet. Finite-difference digital-model results indicate that 3.6 feet of the relative 1953-76 decline was due to pumping in adjacent Queens County and that most of the remaining decline was a result of sewerage. Streamflow within the sewered area decreased in response to the lowered ground-water levels, and ground-water levels in the adjacent unsewered area were also lowered because of the sewerage. (Kosco-USGS)
W80-04099

INTERACTIONS OF MINING AND WATER RESOURCE SYSTEMS IN THE SOUTHEASTERN IDAHO PHOSPHATE FIELD,
Idaho Univ., Moscow. Dept. of Geology.
D. R. Ralston, T. D. Brooks, M. R. Cannon, T. F. Corbet, and H. Singh.
Available from the National Technical Information Service, Springfield, VA 22161 as PB80-160385, Price codes: A11 in paper copy, A01 in microfiche. Idaho Water Resources Research Institute, University of Idaho. Research Technical Completion Report, September 1979. 229 p, 59 Fig, 19 Tab, 71 Ref. OWRT C-7651 (No 7253)(1).

Descriptors: *Idaho, *Base flow, *Groundwater, *Phosphates, *Water pollution sources, Subsurface flow, Hydrogeology, Hydrologic aspects, Aquifer characteristics, Waste disposal, Mathematical models, Environmental effects, Topography, Mining.

Hydrologic and mining related variables were identified and their interaction evaluated to promote effective resource development balanced with conservation management in the Western Phosphate Field located in Idaho, Utah, Wyoming, and Montana. Several phases were involved in the study: the delineation of hydrologic and mining related variables, data collection and analysis from selected sites in Idaho, and the construction of models showing variable interaction. Various groups of environmental factors interacting to shape the water resource systems in the area include: geologic, topographic, hydrologic, climatic, chemical, and biotic. Two mining activities, open pits and waste piles, were found to have the largest potential for affecting water resource systems. A study of stream gains and losses and the locations of springs confirmed a pattern of hydrogeologic characteristics, the 'phosphate sequence', which occurs throughout the area involving groundwater flow in the Dinwoody, Phosphoria, and Wells formations. Two mine areas were studied in detail to obtain additional hydrogeologic insight on flow patterns. Another study showed that chemical leaching and acid production from phosphate waste piles is not a problem. Conceptual models of water resource systems were developed from the theoretical patterns of groundwater flow. The models were used to classify potential mine sites and can be used to evaluate mining impacts on the water resource systems and the hydrologic limitations to mining. A predictive steady state model of the upper Blackfoot River basin was also developed. (Seigler-IPA)
W80-04104

2G. Water In Soils

FIELD MEASUREMENT OF SOIL HYDRAULIC PROPERTIES CHARACTERIZING WATER MOVEMENT THROUGH SWELLING CLAY SOILS,
Soil Survey Inst., Wageningen (Netherlands).
J. Bouma.
Journal of Hydrology, Vol 45, No 1/2, p 149-158, January 1980. 8 Fig, 14 Ref.

Descriptors: *Soil water movement, *Hydraulic properties, *Infiltration, *Expansive clays, Soil properties, Clays, Porous media, Heterogeneity, Cracks, Permeability, *Field measurements, Sampling techniques.

Determination of hydraulic properties in swelling clay soils is difficult due to seasonal variations in pore geometry and to soil structural heterogeneity, requiring large samples. Large in situ columns are therefore prepared to measure K sub sat and K sub unsat near saturation, using the crust test. Soil structure descriptions can be used to estimate optimal sample size. Infiltration into dry or moist clay soil with vertically continuous cracks involves preferential vertical movement of water along the cracks. The resulting irregular moisture distribution does not allow use of many common soil physical techniques, which require homogeneous moisture contents in isotropic soil. (Adams-ISWS)
W80-03935

ANALYTICAL SOLUTIONS FOR PREDICTING SOLUTE MOVEMENT AND THEIR INTERPRETATION IN RECLAMATION,
Central Soil Salinity Research Inst., Karnal (India).
S. K. Gupta, and S. R. Singh.
Journal of Hydrology, Vol 45, No 1/2, p 133-148, January 1980. 6 Fig, 1 Tab, 19 Ref.

Descriptors: *Leaching, *Saline soils, *Model studies, Mathematical models, Equations, Soil water, Soil water movement, Solutes, Salts, Dispersion, Soils, Reclamation, Soil science, Solute movement.

Analytical solutions to the dispersion-convection equation for leaching of saline soils under exponentially decreasing and arbitrary initial salt profile were presented. The soil profile was considered semi-infinite and homogeneous. Another solution incorporating and exponentially decreasing time-varying boundary condition at the surface was developed. The effect of the initial condition and solute transport parameters on the predictive behavior of the model was studied by arbitrarily choosing values of the parameters. The results indicated that the prediction accuracy of the model increases if the initial salt distribution profile is represented by a function which approximates this profile closely. The effect of the time-varying boundary condition is negligible for most practical purposes at or below 15 cm depth of the soil profile. The changes in the transport parameter may not only enhance or retard the pace of reclamation but also affect the final salt distribution in the soil profile. (Sims-ISWS)
W80-03936

CALCULATION OF WATER BALANCE IN THE CROP ROOT ZONE BY COMPUTER,
Indian Agricultural Research Inst., New Delhi. Water Technology Centre.
P. B. S. Sarma, N. H. Rao, and K. V. P. Rao.
Journal of Hydrology, Vol 45, No 1/2, p 123-131, January 1980. 5 Fig, 2 Ref, 1 Append.

Descriptors: *Water balance, *Root zone, *Model studies, Computer models, Mathematical models, Soil water, Soil moisture, Evaporation, Evapotranspiration, Rainfall, Irrigation, Subsurface drainage, Infiltration, Soil water movement, Storage, Computer programs, Computers, Soil science.

A computer program was developed that computes the daily evapotranspiration as a residue from the water balance equation. Moisture profiles from field observations of soil moisture tensions are used as an input into the model. Further, the program evaluates the effects of rainfall or irrigation during the periods of observation and also calculates the water loss from deep drainage. It takes care of the limitation in the availability of data due to occasional skipping of records for two or more days at a stretch. The additional features of this program include the procedures for the computation of infiltration and the moisture flow. The model was applied to actual field data, and the results were presented. (Sims-ISWS)
W80-03937

SOIL SPATIAL VARIABILITY AND ITS CONSEQUENCES ON SIMULATED WATER BALANCE,
Commonwealth Scientific and Industrial Research Organization, Wembley (Australia). Div. of Land Resources Management.
M. L. Sharma, and R. J. Luxmoore.
Water Resources Research, Vol 15, No 6, p 1567-1573, December 1979. 6 Fig, 2 Tab, 20 Ref. DOE W-7405-eng-26.

Descriptors: *Soil properties, *Spatial distribution, *Water balance, *Model studies, Mathematical models, Hydraulic properties, Soils, Evapotranspiration, Vegetation, Vegetation effects, Runoff, Surface runoff, Subsurface runoff, Drainage, Precipitation(Atmospheric), Soil water, Groundwater, Storage, Watersheds(Basins), Hydrology.

Scaling theory, based on the similar media concept, provides a basis for representing soil spatial variability in terms of a single stochastic variable, the scaling factor alpha which is related to the microscopic characteristic length of the soil. Based on the measured properties of alpha (log normally distributed with an arithmetic mean of 1.0 and coefficient of variation of 0.6), the effects of soil spatial variability on the water balance components of a grassland watershed near Chickasha, Oklahoma, were studied by using a simulation model. Monthly simulations of evapotranspiration, surface runoff, deep drainage, and change in soil water storage for the year 1973 were computed for several values of alpha, representing soils with widely ranging hydraulic properties. At any time, vegetation and meteorological parameters were the same for all the soils. Our studies revealed the complexities of soil-plant-atmospheric interactions in evaluating the influence of soil variability on water balance and underlined the limitations of drawing generalizations. The conclusions were highly dependent on the extent of variability (coefficient of variation of alpha), the frequency distribution function of the scaling factor, and the soil-plant-weather combination. (Sims-ISWS)
W80-03947

MEASUREMENT AND NUMERICAL SIMULATION OF HYSTERETIC FLOW IN A HETEROGENEOUS POROUS MEDIUM,
Waterloo Univ., (Ontario). Dept. of Earth Sciences.
R. W. Gillham, A. Klute, and D. F. Heermann.
Soil Science Society of America Journal, Vol 43, No 6, p 1061-1067, November-December 1979. 10 Fig, 2 Tab, 20 Ref. OWRT A-014-COLO(4).

Descriptors: *Mathematical models, *Hysteresis, *Porous media, *Numerical analysis, *Heterogeneity, Hydraulic conductivity, Pressure head, Moisture content, Laboratory tests, Sands, Equations, Equipment, Richards equation, Sand column.

A finite difference solution of the Richards equation was tested experimentally for hysteretic flow in a nonuniform medium. The space-dependent hydraulic properties (water content-pressure head and hydraulic conductivity-water content) were determined experimentally on a laboratory column of sand and were represented in the numerical model by empirical equations. Boundary conditions resulting in hysteretic flow were applied to both the experimental column and the numerical model, and the resulting water content and pressure head profiles were compared. Agreement was excellent between the measured and computed results. An additional simulation, in which the medium was considered to be nonhysteretic, gave good agreement between the measured and computed pressure head values but resulted in substantial error in the computed water content values. (Visocky-ISWS)
W80-04023

THE APPLICATION OF THE GAMMA NEUTRON METHOD FOR TRANSPORT STUDIES IN FIELD SOILS,
CEA Centre d'Etudes Nucleaires de Cadarache, Saint-Paul-Les-Durance (France). Dept. de Biologie.
P. Couchat, P. Moutonnet, M. Puard, and F. Brissaud.
Water Resources Research, Vol 15, No 6, p 1583-1588, December 1979. 11 Fig, 3 Tab, 10 Ref.

Descriptors: *Nuclear moisture meters, *Soil water movement, *Tracers, *Deuterium, Equipment, Instrumentation, Laboratory tests, Gamma rays, On-site investigations, Moisture content, Soils, Soil moisture, Pore water, Soil science.

In order to study water movement in the field, deuterated water was monitored by the gamma neutron method, using 208T1 gamma source and 3He thermal neutron detector. A laboratory device was presented which supplies measurement data on a 5-ml soil solution. The performance of a gamma neutron probe was evaluated, the background count rate which depends on soil moisture content was related to the neutron emission of 208T1 gamma source, the resolution was found to depend on gamma diffusion and was no more than 15 cm in unsaturated soil, and the calibration was given vs. volumetric deuterated water content. The dispersive transport of a D20 pulse on a soil column was studied through a D20 concentration profile and breakthrough curve at the bottom of the column. Then simultaneous measurements of soil water content and D20 concentration by the neutron moisture gage and the gamma neutron probe enabled the authors to interpret the evolution of the D20 pulses as a function of irrigation during a field experiment. (Sims-ISWS)
W80-04032

EFFECTS OF CLEARCUTTING ON SOIL WATER DEPLETION IN AN ENGELMANN SPRUCE STAND,
Utah State Univ., Logan. Watershed Science Unit.
For primary bibliographic entry see Field 4A.
W80-04034

ESTIMATING SOIL WATER RETENTION CHARACTERISTICS FROM PARTICLE SIZE DISTRIBUTION, ORGANIC MATTER PERCENT, AND BULK DENSITY,
Science and Education Administration, St. Paul, MN. Soil and Water Management Research Unit.
S. C. Gupta, and W. E. Larson.
Water Resources Research, Vol 15, No 6, p 1633-1635, December 1979. 3 Fig, 2 Tab, 14 Ref.

Descriptors: *Soil water, *Regression analysis, *Particle size, *Organic matter, *Retention, *Bulk density, Statistical models, Equations, Curves, Soil water movement, Soils, Soil-water-plant relationships, Sands, Silts, Clays, Soil water retention.

Regression models were presented for estimating soil-water-retention curves from particle-size distribution, percentage of organic matter, and bulk density. Models were developed from the measured soil-water-retention curves of artificially packed cores (7.6 x 7.6 cm) of 43 soil materials. These soil materials included 13 agricultural soils. Curves predicted with these models approximated reasonably well the measured water retention of 61 Missouri soils. Because conventional methods of obtaining retention curves are expensive and time consuming, these equations will be valuable for modeling salt and water flow in soils and for estimating available water capacities. (Visocky-ISWS)
W80-04038

SPATIAL VARIABILITY OF INFILTRATION IN A WATERSHED,
Commonwealth Scientific and Industrial Research Organization, Wembley (Australia). Div. of Land Resources Management.
M. L. Sharma, G. A. Gander, and C. G. Hunt.
Journal of Hydrology, Vol 45, No 1/2, p 101-122, January 1980. 13 Fig, 3 Tab, 34 Ref.

Descriptors: *Infiltration, *Correlation analysis, *Heterogeneity, *Watersheds(Basins), *Oklahoma, Analysis, Porous media, Soil properties, Soil physics, Infiltrometers, Unsteady flow, Statistical methods, Loam, *Philip's equation, *Silt loam soils, Field experiments, Log-normal distributions.

Twenty-six infiltration tests were carried out on a 9.6-ha watershed, near Chickasha, Oklahoma. The data from each test were expressed in the form of Philip's two-parameter equation. In most cases this equation could be adequately matched to the data so that the variability of infiltration in the watershed could be expressed in terms of the two parameters, S and A. There was no obvious pattern in the distribution of infiltration parameters with respect to soil type or position in the watershed. Due to large variability within soil units of the watershed, delineation of hydrologically homogeneous zones is not warranted. The range of values of S over the watershed was within an order of magnitude, while that of A was within two orders of magnitude. Parameters S and A were correlated (r = 0.81). The frequency distributions were better approximated by log-normal than by normal distributions. However, assuming a normal distribution for S would not introduce as much error as it would for A. The infiltration data from 26 sites, comprising 618 observations, were scaled according to the concept of similar media, and one value of scaling factor was assigned to the infiltration data of each site. Scaling factors alpha sub S and alpha sub A were computed from the independently determined parameters, S and A. The reduction in error sums of squares of the scaled data was much greater with alpha sub A than with alpha sub S, although the scaling theory states that these factors should be identical. Remarkable improvement in scaling was achieved when the geometric or the harmonic means were used. Results based on the harmonic mean of alpha sub SA were almost identical to those calculated by statistical optimization. The frequency distribution of scaling factors in the watershed was log-normal. (Adams-ISWS)
W80-04062

2H. Lakes

PHOSPHORUS DYNAMICS IN A PIEDMONT RESERVOIR,
North Carolina Univ. at Chapel Hill. Dept. of Environmental Sciences and Engineering.
L. Greer.
Available from the National Technical Information Service, Springfield, VA 22161 as PB80-156235, Price codes: A05 in paper copy, A01 in microfiche. MS Thesis, 1979, 85 p, 14 Fig, 16 Tab. OWRT-A-102-NC(1), 14-34-0001-9035.

Descriptors: *Phosphorus, Phosphorus uptake, Lake stratification, Nutrients, Turnovers, Bacterial uptake, *Reservoirs, Algae, Bacteria, Suspended solids, Lakes, North Carolina, *University Lake(NC), Piedmont, Phosphorus concentration, *Lake nutrients.

A North Carolina Piedmont lake was monitored for physical and chemical characteristics. Interest focused on phosphorus (P) and nitrogen concentrations, and phosphorus uptake by algae, bacteria and suspended sediments. Results indicate that phosphate concentrations from 0.006 mg/l to 0.045 mg/l constituted half and one quarter of the total P in winter and spring, respectively. Bacterial uptake exceeded algal uptake of P at all depths and on all occasions except June. Suspended sediment did not compete favorably with the 2 biotic components and contributed significantly to the uptake of P only during the winter. (DiNardi-NC)
W80-03908

PRELIMINARY OBSERVATIONS ON THE BENTHIC MACROINVERTEBRATE COMMUNITIES OF ROSS BAY, A POLLUTED AREA OF LOUGH LEANE, SOUTH-WEST IRELAND,
University Coll., Dublin (Ireland). Dept. of Zoology.
For primary bibliographic entry see Field 5B.
W80-03934

TURBIDITY-INDUCED MEROMIXIS IN AN OREGON RESERVOIR: HYPOTHESIS,
Army Engineer District, Portland, OR. Hydrology Section.
D. W. Larson.
Water Resources Research, Vol 15, No 6, p 1560-1566, December 1979. 6 Fig, 1 Tab, 17 Ref, 1 Append.

Descriptors: *Reservoirs, *Meromixis, *Turbidity, *Oregon, Stratification, Water temperature, Suspended solids, Sediments, Lakes, Limnology, *Hills Creek Reservoir(OR).

Flood flows into a river impoundment early in its history are believed to have produced a deep-water layer of highly turbid water that persisted owing to the slow settling of suspended material and poor reservoir flushing ability. Subsequent inflows of considerably cleaner water, superimposed on the turbid layer, created a pronounced mid-depth density gradient. Possibly, circulation of water between the two layers was restricted for several years, and a condition regarded as meromictic may have been established. (Sims-ISWS)
W80-03948

CLIMATOLOGICAL ESTIMATE OF THE AVERAGE MONTHLY ENERGY AND WATER BUDGETS OF LAKE TAHOE, CALIFORNIA-NEVADA,
California Univ., Davis. Dept. of Land, Air and Water Resources.
L. O. Myrup, T. M. Powell, D. A. Godden, and C. R. Goldman.
Water Resources Research, Vol 15, No 6, p 1499-1508, December 1979. 11 Fig, 4 Tab, 35 Ref. NSF AEN 22675, NSF DES 75-14375, NSF GA-34099.

Descriptors: *Lakes, *Hydrologic budget, *Energy budget, *California, *Nevada, Water temperature, Air temperature, Meteorological data, Hydrologic data, Runoff, Precipitation(Atmospheric), Discharge(Water), Evaporation, Analytical techniques, Monthly, Analysis, Mathematical models, Lake Tahoe, Limnological data.

An estimate of the average monthly energy and water budgets of Lake Tahoe, California-Nevada, was made from commonly available meteorological, hydrological, and limnological data. The water budget indicates that precipitation, discharge, runoff, and evaporation dominate the water balance in seasonal succession, each associated with an appropriate minimum or maximum in the lake water storage. The annual energy budget is dominated by the net radiation and evaporation terms with 93% of the radiation input used to evaporate water. The seasonal energy budget indicates that (1) energy storage is in phase with the radiation input and is a dominant term in the periods November-January and May-July, (2) evaporation reaches a maximum value in the fall, 3 months after the radiation maximum, (3) upward transfer of sensible heat from the lake surface reaches a maximum another 3 months later, in the winter, and (4) the sensible heat flux is downward in late spring and early summer, indicating stable stratification in the atmospheric surface layer over the lake during this period, a result of possible significance to air quality in the Tahoe basin. The energy storage and sensible heat transfer terms show large fluctuations in the fall which may be associated with large-scale meteorological events during a season in which energy is trapped in the surface waters by stable stratification in the thermocline layer. (Humphreys-ISWS)
W80-03953

USE OF HYPOLIMNETIC OXYGEN DEPLETION RATE AS A TROPHIC STATE INDEX FOR LAKES,
Meta Systems, Inc., Cambridge, MA.
W. W. Walker, Jr.
Water Resources Research, Vol 15, No 6, p 1463-1470, December 1979. 11 Fig, 3 Tab, 24 Ref.

Descriptors: *Lakes, *Water quality, *Dissolved oxygen, *Indicators, Hypolimnion, Trophic level, Eutrophication, Phosphorus, Chlorophyll, Turbidity, Nutrients, Oxygen, Data processing, Analytical techniques, Limnology.

The feasibility of lake water quality management planning has been greatly increased over the past 10 years with the development of relatively simple, empirical methods for assessing eutrophication problems. These relate phosphorus loading, hydrology, and morphometry to such traditional tro-

phic state indices as phosphorus concentration, chlorophyll-a concentration, and transparency. One of the difficulties associated with use of these methods is that water quality criteria, as related to beneficial use, do not generally correspond to subjective definitions of 'trophic state.' This paper attempted to improve upon existing methods by relating measures of phosphorus, chlorophyll-a, and/or transparency to hypolimnetic dissolved oxygen, which is of direct relevance to existing water quality standards, particularly for fisheries management. A modified version of Carlson's trophic state index summarized relationships among summer, epilimnetic measurements of total phosphorus, chlorophyll-a, and transparency. On the basis of data from 30 lakes this index was shown to be highly correlated with areal hypolimnetic oxygen depletion rate when the apparent effects of mean depth were also taken into account (R sq = 0.91). Tests of the empirical model on a separate data base of 86 lakes indicated that the approach can be used to predict oxygen status based upon lake morphometry and trophic index. The methodology provided a link between phosphorus mass balance models and existing water quality criteria for dissolved oxygen. (Sims-ISWS)
W80-03954

FEATURES OF THE STRUCTURE AND TROPHIC LINKS OF PLANKTONIC ASSOCIATIONS IN TWO LAKES WITH DIFFERNET DEGRESS OF SALINITY,
Akademiya Nauk SSSR, Moscow. Inst. of Limnology.
For primary bibliographic entry see Field 5C.
W80-03963

ICHTHYOPLANKTON OF THE ST. LAWRENCE ESTUARY: COMPOSITION, DISTRIBUTION, AND ABUNDANCE,
Rutgers - The State Univ., New Brunswick, NJ. Dept. of Zoology.
K. W. Able.
Journal of the Fisheries Research Board of Canada, Vol 35, No 12, p 1518-1531, December 1978. 13 Fig, 6 Tab, 45 Ref.

Descriptors: *St Lawrence estuary(Canada), *Distribution, *Biomass, *Fish eggs, Plankton, Larvae, Larval growth stage, Fish, Fish establishment, Osmerids, Gadids, Cottids, Cyclopterids, Pleuronectids, Smelts, Spawning, Speciation, Systematics, Spatial distribution, Seasonal, Baseline studies, Canada.

Ichthyoplankton composition, distribution and abundance in the St. Lawrence estuary, including the adjacent Saguenay River and the northwest Gulf of St. Lawrence, were investigated June-July 1973, June-October 1974, and May-September 1975. Estuarine ichthyoplankton are relatively depauperate. Eggs and larvae of 25 species from 14 families were collected; gadid, cottid, cyclopterid and pleuronectid families had the most species. Most abundant larvae were osmerids, capelin (Mallotus villosus) and rainbow smelt (Osmerus mordax), which together made up 91.2%, 87.9% and 98.8% respectively of total larvae collected 1973-1975. Larvae were dominated by species with demersal eggs. Pelagic eggs occurred; however, these were usually from nonresident species. During all 1975 sampling periods, larvae were consistently more abundant in the upper than lower estuary. Larval abundance varied 1.4-860.3 individuals/100 cu m in the upper estuary compared with 0.1-1.0 individuals/100 cu m in the lower estuary. Greater larval abundance in the upper estuary is due to its use as a major spawning (M. villosus, Clupea harengus harengus) and nursery area (C. harengus harengus, O. mordax, Microgadus tomcod). Pelagic eggs and fish larvae are most abundant late May to early June with 99.4% of all larvae taken in early June. (Danovich-Wisconsin)
W80-03965

MULTIOBJECTIVE DYNAMIC PROGRAMMING WITH APPLICATION TO A RESERVOIR,
Illinois Univ. at Urbana-Champaign. Dept. of Civil Engineering.
For primary bibliographic entry see Field 4A.
W80-04025

MULTIOBJECTIVE DYNAMIC PROGRAMMING: A CLASSIC PROBLEM REDRESSED,
Illinois Univ. at Urbana-Champaign. Dept. of Civil Engineering.
For primary bibliographic entry see Field 4A.
W80-04026

RELIABILITY-CONSTRAINED RESERVOIR CONTROL PROBLEMS, 1. METHODOLOGICAL ISSUES,
IBM Thomas J. Watson Research Center, Yorktown Heights, NY.
M. Sniedovich.
Water Resources Research, Vol 15, No 6, p 1574-1582, December 1979. 2 Fig, 1 Tab, 19 Ref.

Descriptors: *Reservoirs, *Reservoir operation, *Reliability, *Model studies, Mathematical models, Analytical techniques, Methodology, Reservoir storage, Reservoir releases, Dynamic programming, Computer models, Computer programs.

A dynamic programming solution procedure was developed for a class of reliability-constrained reservoir control problems associated with constraints defined over the entire life of the reservoir. Certain methodological issues involved in the modeling, analysis, and solution of reservoir control problems were raised, and it was shown how the proposed model can be used to evaluate heuristic release strategies. A simple numerical example was presented. (Sims-ISWS)
W80-04031

ON THE PROBLEM OF DISCRETIZATION IN DAM THEORY,
Caulfield Inst. of Tech., Victoria (Australia).
P. Lochert, and R. M. Phatarfod.
Water Resources Research, Vol 15, No 6, p 1593-1597, December 1979. 2 Fig, 1 Tab, 11 Ref.

Descriptors: *Reservoirs, *Reservoir operation, *Model studies, Mathematical models, Markov processes, Dams, Reservoir releases, Reservoir storage, Inflow, Discharge(Water), Theoretical analysis, Analytical techniques, Probability, Water resources, Discretization, Erlangian inputs, Reservoir theory.

This paper considered the twin problems of the nature of discretization and the size of the unit of discretization in reservoir theory. It compared the probabilities of emptiness and of fullness of the reservoir obtained by the discretization schemes suggested by Moran and Doran. It was proved that the probability of emptiness for the former scheme is always greater than that obtained for the latter scheme. The probability distribution of the reservoir content for the latter scheme was derived for the case when the release is the unit of measurement. Finally, the probabilities of emptiness and of fullness of the reservoir for the two schemes were compared with the exact values for the Erlangian input case. (Sims-ISWS)
W80-04033

THE LINEAR RESERVOIR WITH MARKOVIAN INFLOWS,
Ain Shams Univ., Cairo (Egypt).
A. A. Anis, E. H. Lloyd, and S. D. Saleem.
Water Resources Research, Vol 15, No 6, p 1623-1627, December 1979. 1 Fig, 1 Tab, 27 Ref.

Descriptors: *Reservoirs, *Inflow, *Discharge(Water), *Model studies, Mathematical models, Markov processes, Stochastic processes, Probability, Storage, Theoretical analysis, Analytical techniques, Hydrology, Reservoir theory.

The purpose was to derive the outflow distribution from a linear reservoir fed by a discrete-time gamma-distributed Markovian inflow. A satisfactory continuous time solution was available for the linear reservoir when the inflow distribution has independent increments. For the case of nonindependent increments discussed in the paper the treatment is in terms of a gamma-distributed Markov chain inflow process in discrete time, for which the Laplace transform of the outflow rate distribution was derived. This was inverted, numerically, for a set of typical parameter values. (Sims-ISWS)
W80-04035

A NOTE ON ERROR ANALYSIS FOR A PHOSPHORUS RETENTION MODEL,
Michigan State Univ., East Lansing. Dept. of Resource Development.
K. H. Reckhow, and S. C. Chapra.
Water Resources Research, Vol 15, No 6, p 1643-1646, December 1979. 2 Fig, 4 Tab, 20 Ref.

Descriptors: *Lakes, *Phosphorus, *Limnology, *Michigan, Water quality, Model studies, Analytical techniques, Statistical methods, Mathematical models, Correlation analysis, Variability, Risks, *Lake Charlevoix(MI), Error analysis.

A statistical technique proposed for the estimation of the uncertainty in the prediction of phosphorus concentration in lakes using the Dillon-Rigler-Kirchner model can increase the practical value of this and similar models. The usefulness of this technique can be seen in its application to Lake Charlevoix, Michigan. But there are limitations on the use of this procedure, such as those that relate to model and data uncertainty. The technique described yields only an approximation of prediction uncertainty. This technique does have limitations, and they are as follows: (1) The phosphorus model is based on the assumption of a completely mixed lake. Thus the predicted phosphorus concentration is a spatial and temporal average value. This means that the prediction uncertainty refers to the uncertainty in the prediction as an estimate of the average value; it does not reflect any spatial and temporal variability in an application lake. (2) An empirical model like that proposed by Kirchner and Dillon should not be applied outside the range of conditions represented by the model development data set without prior verification. This constraint on the application of the model is important because the Kirchner-Dillon data set is fairly homogeneous and therefore not representative of the population of north temperate lakes. As a result of this homogeneity, the prediction uncertainty derived from the data probably is an underestimation of total uncertainty when applied to lakes outside the bounds of the data set. (See also W75-08970 and W75-08986) (Humphreys-ISWS)
W80-04040

NUTRIENTS LIMITING PHYTOPLANKTON PRODUCTION IN ICE-COVERED LAKE ST. CLAIR,
Windsor Univ. (Ontario). Dept. of Biology.
For primary bibliographic entry see Field 5C.
W80-04051

SEDIMENT MIXING BY LAMPSILIS RADIATA SILIQUOIDEA (MOLLUSCA) FROM WESTERN LAKE ERIE,
Case Western Reserve Univ., Cleveland, OH. Dept. of Earth Sciences.
For primary bibliographic entry see Field 2J.
W80-04053

PHOSPHATE CHARACTERISTICS AND BIOAVAILABILITY OF SUSPENDED SEDIMENTS FROM STREAMS DRAINING INTO LAKE ERIE,
Ohio State Univ., Columbus.
For primary bibliographic entry see Field 5B.
W80-04054

APPLICATION OF SHORT-TIME SCALE RECORDING METER DATA TO NUMERICAL MODELLING OF TORONTO HARBOUR,
Ontario Ministry of the Environment, Toronto.
For primary bibliographic entry see Field 5B.
W80-04057

VOLATILE CHLORO- AND CHLOROFLUOROCARBONS IN LAKE ERIE--1977 AND 1978,
National Water Research Inst., Burlington (Ontario).
For primary bibliographic entry see Field 5A.
W80-04058

RELATIONSHIPS BETWEEN BACTERIAL POPULATIONS AND OXYGEN LEVELS IN THE CENTRAL BASIN OF LAKE ERIE,
Canada Centre for Inland Waters, Burlington (Ontario); and National Water Research Inst., Burlington (Ontario).
S. S. Rao, and A. A. Jurkovic.
Journal of Great Lakes Research, Vol 5, No 2, p 225-228, 1979. 3 Fig, 1 Tab, 15 Ref.

Descriptors: *Bacteria, *Dissolved oxygen, *Lake Erie, Hypolimnion, Epilimnion, Lakes, Microbiology, Carbon, Oxygen, Nitrogen, Water temperature, Sampling, Data processing, Limnology, Heterotrophic bacteria.

Studies were made to ascertain the relationships between bacteria and particulate organic carbon, particulate nitrogen, and the depletion of oxygen from the hypolimnetic waters of the central basin of Lake Erie. Heterotrophic bacterial populations, dissolved oxygen, particulate organic carbon, and total particulate nitrogen were determined during May, August, and September. Data indicated (1) a relationship between heterotroph populations and dissolved oxygen; (2) epilimnion oxygen concentrations of 9 mg/l were associated with bacterial levels of approximately 4000 colonies per ml; (3) bacterial densities started to increase from the thermocline downward; (4) hypolimnion oxygen levels of approximately 1 mg/l were associated with bacterial densities of approximately three times the epilimnion values; (5) bacterial oxygen uptake rate in the hypolimnion varied from 1.5 to 7.4 x 10 to the minus 10th power mg/l/hr; (6) particulate organic carbon and bacteria showed similar distribution patterns in the water column; (7) particulate nitrogen remained unchanged at 0.1 mg/l in the water column showing no relationship to the other parameters measured. (Sims-ISWS)
W80-04059

CHEMICAL AND BIOLOGICAL QUALITY OF SELECTED LAKES IN OHIO - 1976 AND 1977,
Geological Survey, Columbus, OH. Water Resources Div.
R. L. Tobin, and J. D. Youger.
Geological Survey Water-Resources Investigations 78-109 (open-file report), September 1979. 291 p, 77 Fig, 144 Tab, 49 Ref.

Descriptors: *Ohio, *Lakes, *Limnology, *Water quality, *Lake morphology, Data collections, Thermal stratification, Water chemistry, Nutrients, Phytoplankton, Algae, Bacteria, Pesticides, Anaerobic conditions, Dissolved solids, Dissolved oxygen, Cations, Anions, Light penetration, Secchi disks, Inflow.

Twenty-eight Ohio lakes (14 per year) were evaluated in 1976 and 1977 for water-quality status. Spring and late summer data included physical and profile measurements for a broad spectrum of chemical and biological constituents. Secchi disk transparency ranged from 0.2 to 6.4 meters. Seasonal thermal gradients occurred in all lakes deeper than 5.2 meters and not controlled by subsurface release values. Anaerobic conditions, and high concentrations of ammonia, carbon dioxide, and hydrogen sulfide, developed in all lakes having stable thermal gradients. Maximum dissolved oxygen was measured at 17.8 milligrams per liter (220 percent saturation) in Summit Lake. Calcium, bicarbonate, and sulfate were the principal constituents. Specific conductance varied from 130 to 1250 micromhos. Pesticides residues were not detected and concentrations of trace metals were within State limits. Fecal coliform bacteria counts were generally low and within State standards. Blue-green algae dominated the phytoplankton communities in 18 lakes in spring and 26 lakes in summer. The maximum algal count was 3,400,000 cells per millimeter in Kiser Lake, and algal counts were above 100,000 cells per milliliter in 19 lakes. (Kosco-USGS)
W80-04087

HYDROGEOLOGY AND COMPUTER MODEL OF THE BASS LAKE AREA, ST. CROIX COUNTY, WISCONSIN,
Wisconsin Univ.-Madison. Dept. of Geology and Geophysics.
M. B. Rinaldo-Lee.
Available from the National Technical Information Service, Springfield, VA 22161 as PB80-163660, Price codes: A06 in paper copy, A01 in microfiche. M.S. Thesis, 1978. 95 p, 26 Fig, 3 Tab, 20 Ref. OWRT A-075-WIS(2), 14-34-0001-8053.

Descriptors: *Water level fluctuations, *Lakes, *Dams, *Hydrogeology, *Groundwater movement, Model studies, Groundwater recharge, Inflow, Evaluation, Wisconsin, *Bass Lake(Wisc), *Mounds Pond(Wisc), St. Croix County(Wisc).

Bass Lake is one of several lakes in northern Wisconsin where high water levels in the early 1970's caused flooding of roads and homes. Because Bass Lake is a ground-water dominant lake with no inlet or outlet, it was speculated that high water levels were caused by increased ground-water discharge to the lake brought about by an impoundment, Mounds Pond, on the Willow River. The impoundment is located 1.5 miles to the south and is 12 feet higher than the normal elevation of Bass Lake. In order to determine the probable cause of the high lake levels, an investigation into the hydrogeology of the area was initiated in the field and utilizing the Trescott-Pinder-Larson (1976) computer model to simulate the effects on the lake elevation of changing various parameters. Bass Lake appears to be influenced by a regional flow-through system and a local recharge system in the southern part of the lake and a regional flow-through system in the northern part of the lake. Results of the field study indicate that there is no ground-water flow between Mounds Pond and Bass Lake. Furthermore, computer model simulations indicated that lowering Mounds Pond 10 feet, as had been suggested as a means of alleviating the flooding at Bass Lake, would have no effect on Bass Lake levels. Computer model simulations using an increase in recharge rate and climatological data indicate that an increase in precipitation caused the abnormally high lake levels observed during the early 1970's.
W80-04111

MULTIDATE LANDSAT LAKE QUALITY MONITORING PROGRAM,
Wisconsin Univ., Madison.
For primary bibliographic entry see Field 7B.
W80-04118

PRODUCTION OF VITAMIN B12, THIAMINE, AND BIOTIN BY FRESHWATER PHYTOPLANKTON,
Kochi Univ. (Japan). Faculty of Agriculture.
J. Nishijima, R. Shiozaki, and Y. Hata.
Bulletin of the Japanese Society of Scientific Fisheries, Vol 45, No 2, p 199-204, January 1979. 2 Fig, 3 Tab, 27 Ref.

Descriptors: *Phytoplankton, *Cultures, *Vitamin B, *Primary productivity, *Lake Kojima(Japan), Laboratory tests, Vitamins, Biochemistry, Metabolism, Nutrients, Eutrophication, Chlorophyta, Scenedesmus, Chlorella, Chlamydomonas, Growth stage, Speciation, Growth rates, Age, Japan.

Results of anexic cultures of several freshwater phytoplankton species from Lake Kojima, a eutrophic lake in Japan, suggest that some phytoplankton may significantly contribute to the production of dissolved B-group vitamins found abundantly in the lake. Phytoplankton were isolated from Lake Kojima on 24 April 1972; species include Scenedesmus, Chlorella, Chlamydomonas, Carteria and Chroococcus. Phytoplankton require no vitamins for growth; however, Carteria growth is partially depressed in vitamin-free medium. Thiamine stimulates Carteria growth in early incubation periods. Phytoplankton synthesize and secrete considerable amounts of the B-group vitamins increasingly with culture age. In general, all species except Chroococcus produce biotin, thiamine and B12 in order of concentration in the culture media: biotin 750-4,000 pg/ml medium, thiamine 0-3,400 pg/ml medium and vitamin B12 0.3-20 pg/ml medium after incubation for 17 days. B-group vitamins are generally produced increasingly with culture age over the whole experiment period; however, thiamine production by Carteria begins at the start of the stationary growth phase and increases a little with culture age. Values are mostly as follows: vitamin B12, 100-10 micro pg/cell/d; thiamine 1.0-0.1 micro pg/cell/d (except for Chlamydomonas and Carteria during early log phase); and biotin, 100-10 milli pg/cell/d (except for Chroococcus with 1.0-0.1 nano pg/cell/d). Vitamin production abilities vary with phytoplankton species, growth stage and other growth conditions. (Danovich-Wisconsin)
W80-04169

2I. Water In Plants

URBAN LAWN EVAPOTRANSPIRATION--MEASUREMENT AND PREDICTION,
Pool (Charles) and Associates, Inc., Ketchikan, AK.
For primary bibliographic entry see Field 2D.
W80-04021

SKELETONEMA POTAMOS (WEBER) HASLE AND CYCLOTELLA ATOMUS HUSTEDT (BACILLARIOPHYCEAE) IN THE PLANKTON OF RIVERS IN ENGLAND AND FRANCE,
Institute of Terrestrial Ecology, Cambridge (England); and Culture Centre of Algae and Protozoa, Cambridge (England).
J. H. Belcher, and E. M. F. Swale.
British Phycological Journal, Vol 13, No 2, p 177-182, June 1978. 7 Fig, 16 Ref.

Descriptors: *Diatoms, *Rivers, *Speciation, *England, *France, Plankton, Salinity, Distribution, Analytical techniques, Cytological studies, Microscopy, Size.

This paper is the first report on the occurrence of Skeletonema potamos and Cyclotella atomus in several localities in England and one in France. S. potamos occurred in May 1977 as a minor plankton component from Don River, Yorkshire, and in August 1977 from a tributary of River Colne, Gosfield, Essex. This species was also present in water from River Seine, Paris, France, August 1977. S. potamos forms short filaments of 2-4 cells, each 3-4 micro m wide and 6-10 micro m long sometimes with valves of adjacent cells in contact. Valve centers are flat but have a bevelled edge, so that V-shaped grooves are seen around cell contact areas. Cyclotella atomus was collected from the same river samples as S. potomas, from Trent River near Newark, Nottinghamshire in May 1977 and also from the Thames River at London Bridge in November 1977 in brackish water with 1 ppt salinity. Cells are cylindrical, 3.5-7.0 micro m in diameter. Valve faces are almost flat, but undulate slightly while edges are steeply angled. Frustules have marginal striae surrounding a plainer central area with a single off-center punctum, visible by light microscopy and appearing as a strutted process in electron microscopes. Both species live primarily in freshwater, though have halophilic tendencies. Both are small and could easily be overlooked if present in low numbers. S. potamos has a delicate wall, apt to disintegrate with normal cleaning and mounting procedures and is best recognized alive. (Danovich-Wisconsin)
W80-04120

VOLATILE ORGANIC SULFIDES FROM FRESHWATER ALGAE,
Washington State Univ., Pullman. Dept. of Botany.
For primary bibliographic entry see Field 5C.
W80-04128

PRIMARY PRODUCTION OF ALGAE GROWING ON NATURAL AND ARTIFICIAL AQUATIC PLANTS: A STUDY OF INTERACTIONS BE-

TWEEN EPIPHYTES AND THEIR SUBSTRATE,
McGill Univ., Montreal (Quebec). Dept. of Biology.
A. Cattaneo, and J. Kalff.
Limnology and Oceanography, Vol 24, No 6, p 1031-1037, November 1979. 2 Fig, 2 Tab, 20 Ref.

Descriptors: *Primary productivity, *Lake Memphremagog, Quebec-Vermont, *Macrophytes, *Artificial substrates, *Algae, *Epiphytes, Potamogeton richardsonii, Sampling, Biomass, Aquatic plants, Competition, Substrates, Plant growth, Nutrient requirements, Phosphorus, Symbiosis, Limiting factors, Nutrients, Hosts.

Epiphytes growing ion Potamogeton richardsonii and similar plastic plants in Lake Memphremagog, Quebec-Vermont, during 1976-1977 growing seasons, were similar in biomass and primary production, giving little support to hypothesized symbiosis or competition between plant and epiphytes. P. richardsonii is probably a neutral substrate for epiphytes, whose primary function is to provide epiphytes with suitable support sufficiently high in the water column. However, some interaction between host plants and epiphytes do take place, although they are not reflected by growth and biomass rates. Lower alkaline phosphatase activity of epiphytes growing on natural plants suggests that these algae are less P-limited than those growing on plastic plants and which obtain P from lining macrophytes. Epiphytes growing on plastic leaves offset loss of the macrophytic P source through increased alkaline phosphatase activity. Algae do not experience significant benefit or detriment in terms of growth or biomass by growing on a common macrophyte. Significant interactions between epiphytes and macrophytes should not be automatically assumed. (Harris-Wisconsin)
W80-04131

UPTAKE AND RELEASE OF NUTRIENTS BY AQUATIC MACROPHYTES,
Mankato State Univ., MN. Dept. of Biology.
For primary bibliographic entry see Field 5C.
W80-04136

DISTRIBUTION AND ASPECTS OF THE PRODUCTION AND BIOMASS OF EELGRAS, ZOSTERA MARINA L., AT ROSCOFF, FRANCE,
Katholieke Univ. Nijmegen (Netherlands). Lab. of Aquatic Ecology.
R. P. W. M. Jacobs.
Aquatic Botany, Vol 7, No 2, p 151-172, October 1979. 9 Fig, 3 Tab, 53 Ref.

Descriptors: *Biomass, *Macrophytes, *Roscoff, France, *Primary productivity, *Marine algae, Leaves, Seasonal, Intertidal areas, Turnovers, Rhizomes, Standing crops, Littoral, Tides, Tidal effects, Distribution, Temporal distribution, Growth rates, Spatial distribution, Depth.

At Roscoff, France, Zostera marina (eelgrass) grows to a depth of 4 m below MLWS in sandy bottoms, since all abiotic key parameters except light are consistent throughout this depth, light is the factor most likely responsible for eelgrass lower depth limits. Upper Z. marina limits are influenced by the time of water coverage and dessication. Aboveground biomass, leaf length, number of shoots/sq m correlates with time of water coverage. Biomass and production were measured February 1976-1977. Production was measured by a leaf marking technique together with determination of plastochrone interval, the time interval between the initiation of two successive leaves. Annual production is 1608 g dwt/sq m, maximum leaf biomass 257 g dwt/sq m and maximum total biomass 470 g dwt/sq m. The ratio of net annual production to maximum leaf biomass is 6.3 and that to maximum total biomass 3.4. Total biomass increases from February (190 g dwt/sq m), reaches maximum in August and declines in autumn and winter. Average turnover time for leaves is 68 days and for rhizomes 193 days, indicating that turnover rate of aboveground parts (1.5%/d) is higher than of underground parts (0.5%/d). Average plastochrone interval from April-October is 15.6 days; the mean for the whole year is 19.3 days. A survey on changes in the eelgrass beds since 1909 is also given. (Danovich-Wisconsin)
W80-04137

PHOSPHATASE ACTIVITY AND ITS ROLE IN THE MINERALIZATION OF ORGANIC PHOSPHORUS IN COASTAL SEA WATER,
Tokyo Univ. (Japan). Ocean Research Inst.
For primary bibliographic entry see Field 5F.
W80-04141

GROWTH, CHLOROPHYLL AND MINERAL NUTRIENT STUDIES ON PHALARIS ARUNDINACEAE L. IN THREE SCOTTISH LOCHS,
Dundee Univ. (Scotland). Dept. of Biological Sciences.
For primary bibliographic entry see Field 5C.
W80-04147

2J. Erosion and Sedimentation

TURBIDITY-INDUCED MEROMIXIS IN AN OREGON RESERVOIR: HYPOTHESIS,
Army Engineer District, Portland, OR. Hydrology Section.
For primary bibliographic entry see Field 2H.
W80-03948

IMPACT OF ROAD NETWORKS ON SOUTHEASTERN MICHIGAN LAKESHORE DRAINAGE,
Michigan Univ., Ann Arbor. Dept. of Geography.
For primary bibliographic entry see Field 2E.
W80-03951

SOURCES OF SEDIMENT INDUCED REDUCTIONS IN WATER QUALITY APPRAISED FROM CATCHMENT ATTRIBUTES AND LAND USE,
For primary bibliographic entry see Field 4D.
W80-03967

SEDIMENT MIXING BY LAMPSILIS RADIATA SILIQUOIDEA (MOLLUSCA) FROM WESTERN LAKE ERIE,
Case Western Reserve Univ., Cleveland, OH. Dept. of Earth Sciences.
P. L. McCall, M. J. S. Tevesz, and S. F. Schwelgien.
Journal of Great Lakes Research, Vol 5, No 2, p 105-111, 1979. 4 Fig, 39 Ref. EPA R805716010.

Descriptors: *Sediments, *Mixing, *Benthic fauna, *Mollusks, *Lake Erie, Laboratory tests, On-site investigations, Suspended solids, Moisture content, Oxygen, Lakes, Biology, Limnology, Bivalves, Unionids, Sediment mixing, Mollusks burrowing.

The sediment reworking activities of an abundant Lake Erie unionid bivalve, Lampsilis radiata siliquoidea, were studied by field observations and laboratory experiments. Unionid burrowing in laboratory microcosms increased sediment water content 10-20%, decreased water content variability, homogenized sedimentary structures, and increased tenfold the volume of oxidized sediment over that in microcosms with no unionids. Incomplete mixing of sediment took place to a depth of 10 cm during burrowing by L.r. siliquoidea. Burrowing by other unionids may extend the depth of maximum reworking to 20 cm. Unionid burrowing, feeding, and respiratory activities may alter the profiles of various elements and radionuclides associated with sediment particles and alter the location and intensity of microbial activity in sediments. (Sims-ISWS)
W80-04053

ON THE THRESHOLD OF TRANSPORT OF SAND-SIZED SEDIMENT UNDER THE COMBINED INFLUENCE OF UNIDIRECTIONAL AND OSCILLATORY FLOW,
University Coll. of Swansea (Wales). Dept. of Oceanography.
T. M. Hammond, and M. B. Collins.
Sedimentology, Vol 26, No 6, p 795-812, December 1979. 10 Fig, 1 Tab, 40 Ref.

Descriptors: *Sediment transport, *Laboratory tests, *Sedimentology, *Testing procedures, Cohesionless soils, Methodology, Sediments, Movement, Sands, Currents(Water), Velocity, Streambeds, Waves(Water), Beds, Flow, Open channels, Incipient motion, Oscillatory flow, Flat beds, Critical velocity.

While the transport of sediment by unidirectional currents or by oscillatory (wave-induced) currents has been investigated, very little attention has been paid to the problem of the threshold of transport under the two mechanisms combined. Studies were carried out using cohesionless sand-sized (mean diameters: 142, 363, 771, and 1134 micrometer) quartz grains in a unidirectional flume, within which an oscillatory carriage had been installed. The experiments were carried out under unidirectional velocities ranging between 0 and 27 cm/s, combined with simulated wave-induced currents (at periods of 5 and 15 s) ranging from 0 to 35 cm/s. The threshold of transport was assessed, by visual observation, using the Yalin Criterion for unidirectional flow. This criterion permitted critical conditions to be estimated subjectively by observation of incipient transport from the flat beds. The results indicated the dependence of the critical threshold velocity combination on grain size and wave period. Thresholds tend to increase with increasing grain size or decreasing period. The grain-size dependence is predictable from existing empirical relationships for the separate mechanisms; statistical fluctuations in near-bed stress (bursting), however, are invoked to explain the wave period dependence. The latter effect acts in a reverse manner for wave and current combinations than for waves alone. Graphs are presented, relating grain size to critical threshold velocity combinations, to aid in the sedimentological interpretation of field data. (Humphreys-ISWS)
W80-04060

WAVE-INDUCED LIQUEFACTION: A MODERN EXAMPLE FROM THE BAY OF FUNDY,
McMaster Univ. Hamilton (Ontario). Dept. of Geology.
For primary bibliographic entry see Field 2L.
W80-04061

IMPACT OF NONPOINT POLLUTION CONTROL ON WESTERN LAKE SUPERIOR, RED CLAY PROJECT, FINAL REPORT: SUMMARY,
Environmental Protection Agency, Chicago. IL. Great Lakes National Program Office.
S. C. Andrews, D. S. Houtman, and W. J. Lontz.
Available from the National Technical Information Service, Springfield, VA 22161 as PB-296 200, Price codes: A03 in paper copy, A01 in microfiche. Report EPA 905/9-79-002. January 1979. 32 p, 5 Fig, 4 Tab.

Descriptors: *Nonpoint pollution, *Erosion control, *Lake Superior, *Sedimentation, *Water pollution, *Water pollution sources, *Erosion, Water quality, Water quality control, Water management(Applied), Nutrient loading, Turbidity, Slope stability, Land management, Soil loss, Vegetation effects, Monitoring.

This is the final document of the Red Clay Project, established in May 1974 under an EPA grant to demonstrate new methods for improving water quality in the Great Lakes. The focus of this project was the identification of nonpoint sources of pollution in the Western Lake Superior region. The area's predominant soils are red clays interspersed with sands and silts and are easily erodable. Major nonpoint sources of pollution are lakeshores, streambanks, and other slopes. The Red Clay project was a cooperative Federal-local research and demonstration project established to seek practical solutions to the red clay erosion and resulting water quality problems. The study area was divided into five geographical subdivisions representative of conditions in the entire water-

shed. Studies were undertaken of the condition and behavior of soils within the red clay area in order to utilize available sampling and testing techniques and opportunities to determine areas in which massive slope failure normally occurs. Researchers found that the use of vegetation was significant in erosion control. Red clay turbidity and sedimentation does not add to nutrient loads or oxygen levels in Lake Superior. Possible land management practices are presented. Monitoring of water quality and erosion were conducted at 13 stations, as well as monitoring of rainfall and temperature. Recommendations included keeping a common focus in multiple agency programs, providing cost sharing in nonpoint source pollution management efforts, identification of critical areas through preparation of conservation plans, using a voluntary compliance approach wherever possible, minimizing stream channel deepening, and using streambank vegetative cover wherever possible. A framework is presented for local management agency implementation of project recommendations. (Arnold-NC)
W80-04181

2K. Chemical Processes

EVALUATION OF LIMESTONE NEUTRALIZATION OF ACIDIC ADIRONDACK SURFACE WATERS,
Cornell Univ., Ithaca, NY.
J. J. Bisogni, Jr.
Available from the National Technical Information Service, Springfield, VA 22161 as PB80-158561, Price codes: A03 in paper copy, A01 in microfiche. Center for Environmental Research, Cornell University Research Project Technical Completion Report, March 1980. 26 p, 4 Fig, 5 Tab, 10 Ref. OWRT-A-083-NY(1), 14-34-0001-8034 and 9034.

Descriptors: *Surface waters, Acid neutralization, Acid precipitation, *Acidity, *Neutralization, *Limestones, New York, *Adirondack region(NY), Evaluation, Geochemistry, Water chemistry.

This research project evaluated the use of limestone in packed bed reactors to neutralize acidified Adirondack surface waters (particularly streams). The project was composed of two phases: investigation of sediment-water interactions and evaluation of the kinetics of limestone packed bed reactor neutralization. Experimental results demonstrated that there is little sediment water interaction with regard to hydrogen ion in the Adirondack lakes and streams studied. The results also demonstrated that neutralization of acidified Adirondack surface water by limestone packed bed reactors is feasible. A preliminary design procedure is presented to show this feasibility.
W80-03961

ANALYTICAL METHOD FOR NONIONIC SURFACTANTS IN LABORATORY BIODEGRADATION AND ENVIRONMENTAL STUDIES,
Soap and Detergent Association, New York.
For primary bibliographic entry see Field 5A.
W80-03976

PHOTOSYNTHETIC CARBOXYLATING ENZYMES IN MARINE PHYTOPLANKTON,
Bigelow Lab. for Ocean Sciences, West Boothbay Harbor, ME.
For primary bibliographic entry see Field 5C.
W80-04146

2L. Estuaries

PRELIMINARY OBSERVATIONS ON THE BENTHIC MACROINVERTEBRATE COMMUNITIES OF ROSS BAY, A POLLUTED AREA OF LOUGH LEANE, SOUTH-WEST IRELAND,
University Coll., Dublin (Ireland). Dept. of Zoology.
For primary bibliographic entry see Field 5B.
W80-03934

STABILITY OF RHODAMINE WT IN SALINE WATERS,
Johns Hopkins Univ., Laurel, MD. Applied Physics Lab.
W. D. Stanbro, and D. A. Pyrch.
Water Resources Research, Vol 15, No 6, p 1631-1632, December 1979. 4 Fig, 1 Tab, 4 Ref.

Descriptors: *Rhodamine, *Fluorescent dye, *Tracers, *Saline water, Salinity, Hydrogen ion concentration, Fluorometry, Laboratory tests, Evaluation, Dyes, Estuaries, Dye stability.

The stability of rhodamine WT dye was investigated in buffered and unbuffered NaCl solutions and in natural waters of varying salinity. Despite previous reports in the literature, no significant decay attributable to salinity effects was seen. The maximum decay observed was 5% after 327 hours. (Sims-ISWS)
W80-04036

A NOTE ON DIFFUSION FROM A CONTINUOUS LINE SOURCE IN A TIME VARYING FLOW,
State Univ. of New York at Stony Brook. Marine Sciences Research Center.
For primary bibliographic entry see Field 5B.
W80-04037

APPLICATION OF SHORT-TIME SCALE RECORDING METER DATA TO NUMERICAL MODELLING OF TORONTO HARBOUR,
Ontario Ministry of the Environment, Toronto.
For primary bibliographic entry see Field 5B.
W80-04057

WAVE-INDUCED LIQUEFACTION: A MODERN EXAMPLE FROM THE BAY OF FUNDY,
McMaster Univ. Hamilton (Ontario). Dept. of Geology.
R. W. Dalrymple.
Sedimentology, Vol 26, No 6, p 835-844, December 1979. 4 Fig, 42 Ref.

Descriptors: *Sand bars, *Geomorphology, *Tidal waters, *Intertidal areas, Bays, Sediments, Deformation, On-site investigations, Waves(Water), Tidal effects, Beds, Shape, Ripple marks, Nova Scotia, *Cobequid Bay(Nova Scotia), *Bay of Fundy, Liquefaction.

Soft-sediment deformation features occur commonly on parts of intertidal sand bodies in Cobequid Bay, Bay of Fundy. These features are small- to intermediate-sized, slump-like bodies, 1-3 sq m in area, and located on the crest and upper stoss side of ebb megaripples. External modification of these slumps indicates that they formed before complete emergence. The deformed cross-bedding within these bodies extends to a depth of 0.15-0.35 m and shows that deformation occurred during slumping and flowage of liquefied sand down the megaripple stoss side. Field evidence and calculations strongly indicate that this liquefaction results from the impact of 0.1-0.3 m high waves breaking against the megaripple lee faces. Neither rapid drawdown of the water level nor earthquake shocks are reasonable alternative explanatios. Indigenous wave activity provides an attractive substitute to tectonism as an explanation of soft-sediment deformation in ancient shallow-water sediments. Slow wave-induced compaction may also account for the relative scarcity of deformation structures in shallow marine sand-stones. (Humphreys-ISWS)
W80-04061

SHELF-SEDIMENT DYNAMICS AND SOLID-WASTE DISPOSAL,
University of Southern California, Los Angeles. Dept. of Geological Sciences.
For primary bibliographic entry see Field 5C.
W80-04063

THE PROBLEM OF MISPLACED SEDIMENT,
Virginia Inst. of Marine Sciences, Gloucester Point.
For primary bibliographic entry see Field 5C.
W80-04071

SOME PHOTOSYNTHETIC CARBON FIXATION PROPERTIES OF SEAGRASSES,
Tel Aviv Univ. (Israel). Dept. of Botany.
For primary bibliographic entry see Field 5C.
W80-04129

ORIGINS OF OCEANIC PLANKTON IN THE MIDDLE ATLANTIC BLIGHT,
California Univ., Santa Barbara. Marine Science Inst.
J. Cox, and P. H. Wiebe.
Estuarine and Coastal Marine Science, Vol 9, No 5, p 509-527, November 1979. 6 Fig, 5 Tab, 58 Ref. ONR N00014-74-C0262, NR083-004.

Descriptors: *Eddies, *Zooplankton, *Species composition, *Middle Atlantic Bight, *Atlantic Coastal Plain, *Currents(Water), Gulf Stream, Continental shelf, Continental slope, Speciation, Meanders, Water circulation, Movement, Atlantic Ocean, Northeast U.S., Oceans, Physical properties, Flow, Sargasso Sea, Ocean circulation.

Introduction of expatriated zooplankton species into the mid-Atlantic Bight is largely associated with advective water movements onto the continental shelf. Arctic-Boreal species are brought in from the northeast largely by over-shelf transport. Transition zone species are brought in by slope water penetration, at the surface when horizontal density gradients are minimal and at mid-depth in response to physical processes such as estuarine-type circulation, wind-driven upwelling, cold-shelf water 'bubble' formation and movement out into slope waters, or shelf-slope water interactions associated with warm core eddies or rings. Tropical-subtropical species that commonly reside in the Gulf Stream and Sargasso Sea also occur in the mid-Atlantic Bight due to injections of warm core ring surface waters over the shelf. The Bight area is divided into three regions with regard to oceanic influences: (1) low salinity waters along the coast south of the Hudson River extending to Chesapeake Bay; (2) the continental shelf edge extending outward from Long Island Sound to past Delaware Bay; (3) the southern sector, including the shelf edge south of 37 degrees N and extending landward south of Chesapeake Bay. Cluster analysis of seasonal transect data off New Jersey verifies the faunal distinctness of regions 1 and 2. Region 1 shows little oceanic influence in terms of expatriate species due to 31 ppt salinities. Region 2 is occupied by slope water species and roughly defines the limits of the cold water species. The southern sector is characterized by warm water species. (Danovich-Wisconsin)
W80-04132

PHYSIOLOGICAL ASPECTS OF PRIMARY PRODUCTION IN SEAGRASSES,
Gatty Marine Lab., St. Andrews (England).
E. A. Drew.
Aquatic Botany, Vol 7, No 2, p 139-150, October 1979. 10 Fig, 4 Tab, 12 Ref.

Descriptors: *Marsh plants, *Primary productivity, *Photosynthesis, *Temperature, *Plant physiology, *Estuarine environments, Irradiation, Laboratory tests, Speciation, Respiration, Leaves, Chlorophyll, Light, Light intensity, Thermal stress, Water temperature, Aging(Biological), Photoperiodism, Estuaries, Grassed waterways, Seasonal.

Laboratory experiments on six seagrass species show that all have similar, classic photosynthesis versus irradiance curves which are usually light-saturated at 2-3 mW/sq cm PAR, and have correspondingly low compensation irradiances since their dark-respiration rates are relatively low. Light-saturated photosynthetic rates vary 26.0-8.1 micro C/sq cm h, depending on species. Maximum photosynthetic rate does not correlate with potential depth distribution; an intertidal species, Phyllospadix torreyi, has the highest rate and one from 33 m, Posidonia oceanica, has the lowest. Light-saturated photosynthetic rates increase in direct proportion to temperature increases up to 30-35C.

above which thermal damage causes rapid reduction. Respiration rates are not so dramatically affected by increasing temperatures. Photosynthetic rates closely correlate with chlorophyll content up to 50-60 micro chl/sq cm. P. oceanica shows marked seasonal photosynthetic rate variations high in spring and low in summer. Low summer rates result from reduced chlorophyll content due to general leaf senescence in this species in early summer. Chloroplast movement in Halophila stipulacea is complex and reduces photoinhibition. Species used in experiments include Cymodocea nodosa, H. stipulacea, P. torreyi, P. oceanica, Zostera angustifolia and Z. marina. (Danovich-Wisconsin)
W80-04134

A DIATOM ASSEMBLAGE LIVING BELOW THE SURFACE OF INTERTIDAL SAND FLATS,
Bristol Univ. (England). Dept. of Botany.
F. E. Round.
Marine Biology, Vol 54, No 3, p 219-223, 1979. 2 Fig, 1 Tab, 14 Ref.

Descriptors: *Diatoms, *Barnstable Harbor(MA), *Sediments, *Intertidal areas, *Spatial distribution, *Vertical migration, Ecology, Sands, Speciation, Distribution, Tides, Habitats, Tidal effects, Light, Light intensity, Color, Depth, Drying, Systematics, Amphora cymbifera, Diurnal.

A non-migratory endopsammic diatom association was discovered living below the sand surface of intertidal flats at Barnstable Harbor, Massachusetts. Top sand layers (1 mm) are brown due to dense Hantzschia virgata populations; this species migrates to the surface during tidal exposure. H. virgata moves freely in the spaces between and over sand grains. The colorless middle layer (3 mm) is a mixed zone. H. virgata migrates downwards from the surface layer into this layer prior to dusk. The lowermost layer (3 mm thick) lies above the black anaerobic zone. Large motile pennate species, which presumably do not migrate (Navicula cancellata, Nitzschia spathulata), inhabit this area. Small epipsammic species are also abundant; however, Amphora cymbifera, which attaches to sand grains, characterizes this zone. While this A. cymbifera assemblage is strictly part of the epipsammic community, it differes from the more widespread epipsammic flora in its spatial distribution. Visual observation reveals a much greater cell concentration below 3-4 mm depth. Light intensity is less at greater depths; however, desiccation is a limiting factor in surface layers. Movement of surface sand during tidal covering and uncovering also leads to species loss from sand grains. (Danovich-Wisconsin)
W80-04143

3. WATER SUPPLY AUGMENTATION AND CONSERVATION

3A. Saline Water Conversion

TECHNICAL AND ECONOMIC EVALUATION OF AN MSF SOLAR ENERGY POWERED DESALINATION PLANT,
S. Arazzini, G. Tomei, E. Ciccone, and G. Fiorito.
Desalination, Vol 31, No 1-3, p 443-455, October 1979. 5 Fig, 1 Tab.

Descriptors: *Solar energy, *Economic feasibility, *Desalination plants, *Technology, *Systems analysis, *Cost analysis, Solar distillation, Water treatment, Desalination processes, Desalination apparatus, Water purification, Economics, Costs, Design, Design criteria, Economic justification, Electric power, Reliability, Evaluation.

The most feasible desalination plant powered by solar energy, considering technical and economic aspects, is one using a single field of double axis tracking collectors. Besides its low cost, it presents the easiest plant arrangement and process parameters control. The type of desalting unit chosen is the multistage flash (MSF) with brine recirculation, since it allows the greatest guarantee of reliability over long time periods. High solar energy costs necessitate the highest performance ratio values that can be obtained; the plant is designed as a 500 cu m/d, 46 stage, cross-tube type with 121C top brine temperature and 38.5 Kcal/kg distillate specific heat consumption. Different systems to trap solar energy are considered, taking into account process parameters such as: outlet fluid temperatures from solar receivers, performances, power production system, power consumptions, energy storage, back-up and energy integration systems, and desalting and solar equipment reliability. Three different solutions are examined: (1) double axis collectors with a main storage tank volume; (2) double and single axis collectors with oil and pressurized water tank volumes; and (3) double and single axis collectors with electrical storage (batteries). A solar powered desalting plant is not only feasible, but also attractive economically at least in some countries. (Danovich-Wisconsin)
W80-04155

3C. Use Of Water Of Impaired Quality

IMPACT OF WASTE DIVERSION ON WATER QUALITY IN LAKES,
Limno Tech, Inc., Ann Arbor, MI.
P. L. Freedman, and R. P. Canale.
Journal of the Environmental Engineering Division, ASCE, Vol 105, No 5, p 867-881, October 1979. 5 Fig, 3 Tab, 15 Ref.

Descriptors: *Water quality control, *Waste water disposal, *Diversion, *Lake renewal, *Spray irrigation, Lakes, Trophic level, Nutrients, Michigan, Muskegon Lake(MI), Mona Lake(MI), White Lake(MI), Phosphorus, Chlorophyll, Secchi disks, Waste water treatment, Sampling, Water utilization, Eutrophication.

In 1973, Muskegon County, Michigan began diversion of industrial and municipal wastewater discharges from Muskegon, Mona, and White lakes in an effort to reverse environmental and economic degradation in the region and to meet stringent U.S. Environmental Protection Agency effluent standards. The wastewater was pretreated in aerated lagoons, disinfected, and sprayed on agricultural land. Drainage from the spray irrigation site was collected and discharged to the tributaries of three lakes. The extensive limnological investigation conducted in conjunction with the project focused on eutrophication-related parameters. Tributary and lake sampling began prior to wastewater diversion in 1972 and continued through 1975. Sampling was conducted approximately biweekly during the ice-free season, and monthly during the ice season. Fourteen sampling locations were selected to assess the spatial variation of water quality in each lake and to evaluate the importance of various point sources of contamination. The wastewater treatment has resulted in a significant decrease of phosphorus concentrations in Mona and Muskegon lakes, and in a decrease of chlorophyll-a in Muskegon and White lakes. None of the lakes experienced significant improvements in Secchi disc transparency. The diversion project has altered the overall condition of the lakes in such way that the lakes should be responsive to additional reductions in nutrient loadings. (Harris-Wisconsin)
W80-04144

3D. Conservation In Domestic and Municipal Use

THE COSTS AND BENEFITS OF WATER METERING,
International Bank for Reconstruction and Development, Washington, DC. Energy Water and Telecommunications Dept.
For primary bibliographic entry see Field 6B.
W80-03974

ECONOMICS AND WATER CONSERVATION PART 2,
Department of the Interior, Washington, DC. Office of Minerals Policy and Research Analysis.
R. K. Schaefer.
Water and Sewage Works, Vol 126, No 8, p 28-30, August 1979. 3 Fig, 7 Tab.

Descriptors: *Water conservation, *Water rates, *Economics, *Elasticity of demand, Costs, Water costs, Rates, Economic impact, Social aspects, Water utilization, Consumptive use, Income, Water demand, Utilities, Pricing, Economic efficiency, Public health, Safety, Potable water.

This second half of a two-part article concerning various economic incentives for water conservation, deals specifically with the influence of elasticity and rate structure on use patterns. The foremost principal of conservation is to minimize total water use costs to the community and not necessarily the rate per unit water. Knowledge of demand elasticities for different water uses is important in estimating effects of pricing policies or rate structure relative to conservation objectives. Water demands are generally inelastic (-0.1 to -0.5) but some water uses such as lawn-watering are elastic (-0.5 to -1.2). Efficient and equitable rate structures create awareness of water resource problems. Uniform rates reward water conservation if the total bill is reduced when less water is used. Where average costs are rising, the average or uniform rate is not necessarily equitable; those who conserve water have to pay more per unit because of large water use by others. Decreasing block rates encourage water use. Increasing block rates are the most effective rates to achieve water conservation, flow-reduction objectives. Fairness problems with increasing block rates raise basic questions: (1) the major objective of utilities is to provide safe, potable water; (2) there is a payment burden of prior residents to pay higher costs caused by demands of newer residents. The increasing block rate is efficient in that it places utilities in competition for disposable income at high water-consumption levels but allows them to meet their public service, health and safety functions at minimum cost to consumers. (See also W80-01970) (Danovich-Wisconsin)
W80-04149

3F. Conservation In Agriculture

URBAN LAWN EVAPOTRANSPIRATION--MEASUREMENT AND PREDICTION,
Pool (Charles) and Associates, Inc., Ketchikan, AK.
For primary bibliographic entry see Field 2D.
W80-04021

4. WATER QUANTITY MANAGEMENT AND CONTROL

4A. Control Of Water On The Surface

USE OF EXTREME VALUE THEORY IN ESTIMATING FLOOD PEAKS FROM MIXED POPULATIONS,
Utah Water Research Lab., Logan.
For primary bibliographic entry see Field 2E.
W80-04015

MULTIOBJECTIVE DYNAMIC PROGRAMMING WITH APPLICATION TO A RESERVOIR,
Illinois Univ. at Urbana-Champaign. Dept. of Civil Engineering.
G. W. Tauxe, R. R. Inman, and D. M. Mades.
Water Resources Research, Vol 15, No 6, p 1403-1408, December 1979. 3 Fig, 13 Ref. OWRT B-105-ILL(3).

Descriptors: *Water resources, *Reservoirs, *Dynamic programming, *Model studies, Mathematical models, Computer models, Mathematics, Equations, Management, Water

management(Applied), Reservoir operation, Storage, Powerplants, Hydroelectric power, Evaporation, Analytical techniques.

The analysis of water resource problems often involves noncommensurable objectives. Where this is the case, no clear-cut optimum solution exists, but rather a whole set of technologically efficient 'noninferior' solutions exists. A water resources decision maker, who reflects society's preferences, chooses the single noninferior solution preferred to all the others. Multiobjective dynamic programming was introduced as an extension of dynamic programming which can provide the decision maker with the entire noninferior set of solutions as well as the explicit trade-offs between noncommensurable objectives at all objective levels to aid him in the decision-making process. The technique made possible the quantitative analysis of multiple-objective problems which would provide great difficulties for the existing methods. An example of such a problem was presented and solved by multiobjective dynamic programming. The problem involved the generation of the noninferior set and trade-off curves for the operation of a reservoir considering three objectives. (Sims-ISWS)
W80-04025

MULTIOBJECTIVE DYNAMIC PROGRAMMING: A CLASSIC PROBLEM REDRESSED,
Illinois Univ. at Urbana-Champaign. Dept. of Civil Engineering.
G. W. Tauxe, R. R. Inman, and D. M. Mades.
Water Resources Research, Vol 15, No 6, p 1398-1402, December 1979. 1 Fig, 16 Ref. OWRT B-105-ILL(2).

Descriptors: *Water resources, *Reservoirs, *Planning, *Model studies, Mathematical models, Dynamic programming, Computer programs, Mathematics, Equations, Management, Reservoir operation, Storage, Irrigation, Water management(Applied), Analytical techniques.

The problem of noncommensurable multiple-objective functions in water resources and potential methods for solving such multiobjective problems were discussed. A new method, namely, multiobjective dynamic programming (MODP), that borrows from conventional dynamic programming, was developed. It generates the entire noninferior solution set of the multiobjective problem, and it can be used to generate the trade-off ratios between objectives. The trade-off ratios are actually a by-product of the MODP method and are available explicitly between all objectives. The noninferior solution set is obtained solely in terms of the objectives rather than in terms of the individual decisions that influence each objective, thus facilitating the decision maker's task in choosing the preferred solution. The Reid-Vemuri multiobjective problem in water resources was chosen as an example and was successfully solved using MODP. (Sims-ISWS)
W80-04026

EFFECTS OF CLEARCUTTING ON SOIL WATER DEPLETION IN AN ENGELMANN SPRUCE STAND,
Utah State Univ., Logan. Watershed Science Unit.
G. E. Hart, and D. A. Lomas.
Water Resources Research, Vol 15, No 6, p 1598-1602, December 1979. 2 Fig, 4 Tab, 16 Ref. UTA 777.

Descriptors: *Clear-cutting, *Soil water, *Water yield, *Utah, Lodgepole pine trees, Soil moisture, On-site tests, Watersheds(Basins), Evapotranspiration, Demonstration watersheds, Water equivalent, Water yield improvement, Watershed management, Engelmann spruce trees, Soil water depletion.

Soil water depletion was monitored for five growing seasons on 0.4-hectare plots in a mature stand of Engelmann spruce in northern Utah. Three plots were then clear-cut, and in the first season soil water depletion was 20 to 25 cm less than on an uncut plot. This change, which represents a savings of water previously lost to evapotranspiration, is considerably greater than reported for comparable studies in aspen and lodgepole pine. The effects of clear-cutting on soil water depletion are expected to persist for as many as 50 years. In the first winter after cutting, peak snow water equivalent in the clear-cut plots averaged 91 cm, or 31 cm greater than for the uncut control plots. (Humphreys-ISWS)
W80-04034

POST-WAR LAND DRAINAGE, FERTILIZER USE AND ENVIRONMENTAL IMPACT IN NORTHERN IRELAND,
New Univ. of Ulster, Coleraine (Northern Ireland). School of Biological and Environmental Studies.
D. N. Wilcock.
Journal of Environmental Management, Vol 8, No 2, p 137-149, 1979. 4 Fig, 3 Tab, 23 Ref.

Descriptors: *Drainage programs, *Fertilization, *Environmental effects, *Northern Ireland, Drainage districts, Streamflow, Water quality, Fish management, Legislation, Drainage area, Watersheds(Basins), Tributaries, Sediment transport, Rivers.

Coordinated efforts to implement land drainage schemes in Ireland date to 1842, when 113 drainage districts were established throughout the country. However, most of the drainage schemes predating 1940 were piecemeal and ineffective. In 1947, the Drainage Act introduced a comprehensive strategy of land drainage into which local field drainage schemes were later integrated. In order to implement the Act, a Drainage Council was established. Between 1947 and 1977, the Council has designated 212 rivers (1,878 km) as the main arteries. Projects on these rivers varied in size and type of work performed. Some projects involved removal of local obstructions to flow, major channel realignments and substantial widening of the rivers. Since 1948, the total benefit area was 38,366 ha. In addition, efforts were made to improve outflow conditions in the tributaries of the main rivers. Between 1947 and 1976, 3,250 km of tributary channels have been improved. Under the auspices of the same program, financial assistance was made available for urban and rural drainage projects and fertilizer use. The improvements affected streamflow, water quality and fish production. However, research on the relationship between the drainage schemes and the resultant environmental impacts in Ireland has just begun. It is not known how drainage projects affected streamflow. Also, more research is needed to evaluate the effect of increased fertilizer use and sediment transportation on water quality and fish production. (Harris-Wisconsin)
W80-04115

UPTAKE AND RELEASE OF NUTRIENTS BY AQUATIC MACROPHYTES,
Mankato State Univ., MN. Dept. of Biology.
For primary bibliographic entry see Field 5C.
W80-04136

THE 1976-1977 CALIFORNIA DROUGHT--A REVIEW,
California State Dept. of Water Resources, Sacramento.
For primary bibliographic entry see Field 2E.
W80-04189

4B. Groundwater Management

EFFECT OF INFILTRATION RATE ON BIOLOGICAL CLOGGING AND WATER QUALITY CHANGES DURING ARTIFICIAL RECHARGE,
Tohoku Univ., Sendai (Japan). Dept. of Civil Engineering.
T. Okubo, and J. Matsumoto.
Water Resources Research, Vol 15, No 6, p 1536-1542, December 1979. 12 Fig, 4 Tab, 8 Ref.

Descriptors: *Artificial recharge, *Clogging, *Infiltration rates, Laboratory tests, Mathematical models, Infiltration, Water reuse, Biology, Dissolved oxygen, Ammonia, Chemical oxygen demand, Recharge, Waste water disposal, Hydraulic conductivity, Groundwater movement, Groundwater, Biological clogging.

The effect of infiltration rate on biological clogging and water quality changes was investigated experimentally using a sand column. The concentration of soluble COD in the effluent was stable during 3 months of infiltration, and the lower the initial infiltration rate was, the higher the average percentage of the reduction of soluble COD became. The soluble COD was primarily removed in the surface layer. The hydraulic conductivity in the bottom layer decreased at the highest infiltration rate. The variation of infiltration rate was divided into four stages. In addition, the biological-clogging model was proposed, and the mechanism of biological clogging was discussed. (Sims-ISWS)
W80-03950

THE BALANCE OF GROUNDWATER RESOURCES OF THE EUROPEAN COMMUNITY: A METHODOLOGY FOR A MULTINATIONAL PROBLEM,
Strasbourg-1 Univ. (France).
J. J. Fried, and M. Zampetti.
Water Supply and Management, Vol 3, No 3, p 201-204, 1979.

Descriptors: *Groundwater, *Groundwater resources, *European community, *Water supply, *Groundwater management, *Model studies, *Environmental protection, Resources, Water resources, Groundwater availability, Groundwater utilization, Groundwater potential, Protection, Groundwater recharge, Exploration.

A major part of the freshwater resources available in the European Community is made up of groundwater. The Commission of European Communities is thus emphasizing actions of protection and management of water resources and particularly of groundwater resources. It has undertaken a series of studies on the availability of water resources, management methods, medium and long-term supply problems, integrated management, and classification of community territory on the basis of environmental characteristics. Based on these studies a new study is underway which should produce a quantitative assessment of groundwater resources. The aim is to estimate the available resources in present conditions of recharge and exploitation as well as potential development areas and complementary resources. Only existing data will be used. The hydrogeological results will be made available in 1979. The study is led by consultants and a coordinator who will present the final synthetical analysis. In addition, to cope with any difficulties and to harmonize the scientific approaches there is a panel to debate fundamental questions and common technical problems. In addition to the synthetical report, national reports and four community maps (aquifer inventory, hydrogeological situations, exploration, available resources) will be published. (Iervolino-NC)
W80-04182

4D. Watershed Protection

SOURCES OF SEDIMENT INDUCED REDUCTIONS IN WATER QUALITY APPRAISED FROM CATCHMENT ATTRIBUTES AND LAND USE,
H. W. Anderson.
In: Proceedings of Third World Congress on Water Resources, Mexico City, Mexico, April, 1979. Vol 8, p 3603-3613, 1979. International Water Resources Association, Mexico City.

Descriptors: *Sedimentation, *Water quality, Erosion, *Suspended sediment, Geology, Faults, Landslides, Topography, Slope, Channels, Forest fires, Logging, Lumbering, Watershed management, Streamflow, Snow, Geomorphology, Elevation, Grasslands, *Sediment transport, *Land use, Watesheds(Basins), Regression analysis, Principal components, Rain-snow frequency, Catchments, Channel slope, Grazing, Vegetation, Sediment sources, Turbidity.

Suspended sediment measurements from 61 northern California watersheds were utilized in relating normalized suspended discharge to 10 watershed attributes. Suspended sediment was normalized by using long-term streamflow of each watershed. Factor analysis showed no confounding among the 10 variables; regression on principal components gave an explained variance of 0.73. Landslide potential contributed 42 percent of the explained variance; land-use variables 30 percent; streamflow and rain-snow frequency, 14 percent; geology including faults, 11 percent; and channel slope the other 3 percent. The regression coefficients indicated that watershed shape was the least important variable, with palm-shaped watershed having only 13 percent more sediment discharge than dendritic-shaped watersheds. Different landslide classes produced the greatest differences in sediment discharge: sediment discharge from landslide class 6 was 12 times as great as that from class 1. Use of the results were illustrated in separating normal from accelerated sediment production in the Redwood Creek basin. A separate analysis related landslide class to 6 watershed attributes and broad geologic rock types.
W80-03967

MULTIOBJECTIVE OPTIMIZATION IN WATER QUALITY AND LAND MANAGEMENT,
Virginia Univ., Charlottesville. Dept. of Environmental Sciences.
For primary bibliographic entry see Field 5B.
W80-04027

WATER QUALITY AND MINING: A MANAGEMENT PLAN.
North Carolina Dept. of Natural Resources and Community Development, Raleigh. Div. of Environmental Management.
For primary bibliographic entry see Field 5G.
W80-04180

5. WATER QUALITY MANAGEMENT AND PROTECTION

DEPOSITIONAL CHARACTERISTICS OF SEDIMENTS AT A LOW ENERGY OCEAN DISPOSAL SITE, SAVANNAH, GEORGIA,
Skidaway Inst. of Oceanography, Savannah, GA.
G. F. Oertel.
In: 'Ocean Dumping and Marine Pollution--Geological Aspects of Waste Disposal,' p 97-107, 1979. 3 Fig, 10 Ref. Palmer, H.D. and Gross, M.G. (Eds). Dowden, Hutchinson and Ross, Inc, Stroudsburg, Pa.

Descriptors: *Waste disposal, *Water pollution effects, *Sediments, Sedimentation, Environmental effects, Georgia, *Outer Continental Shelf, *Dredged material, Ocean dumping, Savannah Harbor.

Since the early 1900's, the bar-channel system of the Savannah navigation channel has been dredged for maintenance and improvement. Between 1967 and 1977, approximately 10.8 x 1,000,000 cu yds (8.3 x 1,000,000 cu meters) of this dredge material was deposited at a predetermined ocean disposal site. The prominent sources of material dredged from the navigation channel are fine-grained river deposits, littoral sands, Pleistocene river gravels, and submarine Miocene outcrops. Material that is released from hopper dredges is hydraulically sorted as it settles through the water column. Coarse material is deposited in relatively thick mounds corresponding to the disposal path of the dredge, thin layers of fine material accumulate in deeper areas adjacent to mounds. After deposition, the fine and coarser material is relatively stable during non-storm conditions. During storm conditions, coarse material in the upper parts of the mounds are reworked by waves and storm currents. (Sinha-OEIS)
W80-04067

5A. Identification Of Pollutants

CHEMISTRY OF WATER MILFOIL TISSUE: SEASONAL VARIATION IN SUBMERSED APICES,
New Hampshire Univ., Durham. Dept. of Botany and Plant Pathology.
K. D. Kimball, and A. L. Baker.
Available from the National Technical Information Service, Springfield, VA 22161 as PB80-159726, Price codes: A04 in paper copy, A01 in microfiche. Water Resources Research Center, University of New Hampshire Research Report 25, 1980. 47 p, 46 Fig, 3 Tab, 35 Ref. OWRT A-043-NH(3), A-052-NH(1).

Descriptors: *Minerals, *Chemical properties, *Plant tissues, *Submerged plants, Phosphorus, Sodium, Potassium, Calcium, Magnesium, Iron, Manganese, Zinc, Copper, *Water pollution effects, *Seasonal variations, *Myriophyllum heterophyllum, *Mineral levels, *Water milfoil, Lake Winnipesaukee(NH), Nutrient availability.

The mineral composition of submersed apices in Myriophyllum heterophyllum from Lake Winnipesaukee were analyzed from 1976 through 1978. Seasonal changes in ash, phosphorus, sodium, potassium, calcium, magnesium, iron, manganese, zinc and copper were quantified. The magnitude of the seasonal and spatial variations in mineral tissue levels is large. Ash, phosphorus, sodium, potassium, calcium and magnesium vary by a factor (max/min) of 3-5 during an annual cycle. Variations for iron, manganese and zinc are much greater, with max/min ratios of 13-64. Our results question the practicality and validity of reported techniques which use mineral concentrations as an index of nutrient availability and as monitors of aquatic pollutants. We also conclude that inter- and intraspecific comparisons in the chemical composition of aquatic plants should include seasonal analysis on the different plant tissues, if nutrient dynamics and interrelationships of rooted aquatic plants with water and sediment chemistry are to be understood.
W80-03910

HUMAN VIRUSES IN THE AQUATIC ENVIRONMENT: A STATUS REPORT WITH EMPHASIS ON THE EPA RESEARCH PROGRAM.
Environmental Research Center, Cincinnati, OH. Report to Congress No EPA-570-9-78/006, December 1978. 44 p, 1 Fig, 2 Tab, 88 Ref, 2 Append.

Descriptors: *Viruses, *Disease, *Public health, *Potable water, *Human diseases, Epidemiology, Water pollution sources, Sewage treatment, Environmental sanitation, Water sampling, Sanitary engineering, Water purification, Disinfection, Indicators, Analytical techniques.

Knowledge on the transmission of waterborne enteric human viruses is reviewed. Approximately 100 such viruses are excreted in large numbers in the feces of infected individuals. While the viruses do not multiply in aquatic environments they may survive for long periods of time and may be present in drinking waters. While outbreaks of viral diseases caused by drinking sewage-contaminated water are well documented, the role of 'acceptable' drinking water in this transmission is not clear. The Environmental Protection Agency (EPA) has been active in the development of methods for the recovery of low numbers of viruses from large water samples. Viral detection methods have improved in the past 15 years but are still not adequate to assess the possibility of extremely low levels of viruses existing in 'acceptable' drinking water. Also due to the common person-to-person spreading of these diseases it is difficult to access the role of drinking water in the transmission. EPA has collected and tested 250 drinking water samples from 56 systems in the past 6 years with no viral isolations having been made. Other laboratories have made some confirmed isolations from treated drinking water samples but better detection techniques are needed. Despite much research and study the possibility of 'focal infections', those caused by ingestion of water containing very low levels of virus, has been neither proved nor disproved. It currently appears that full conventional water treatment is needed to provide a reasonable assurance of virologically safe drinking water. Recommendations are made for the improvement of recovery methods and for the development of more effective sewage treatment. (Seigler-IPA)
W80-03922

CHARACTERIZATION OF THE WATER QUALITY IN THE SAINT LAWRENCE RIVER: DETERMINATION OF HOMOGENEOUS ZONES BY CORRESPONDENCE ANALYSIS,
Institut National de la Recherche Scientifique, Rimouski (Quebec).
M. Lachance, B. Bobee, and D. Gouin.
Water Resources Research, Vol 15, No 6, p 1451-1462, December 1979. 6 Fig, 4 Tab, 12 Ref.

Descriptors: *Water quality, *St. Lawrence River, *Correlation analysis, Nitrogen, Phosphorus, Turbidity, Nutrients, Sampling, Data processing, Analytical techniques, Rivers, Pollutants, Water pollution, Spatial distribution.

The application of correspondence analysis to data for turbidity, inorganic nitrogen, and inorganic phosphorus gathered at 112 stations located in the Cornwall-Quebec reach of the Saint Lawrence River allows the behavior of these three parameters to be detailed. A cluster analysis applied to the results of correspondence analysis leads to the definition of homogeneous zones which are characterized by values of the three parameters considered. The results obtained enter into the design processes of quality network for the Saint Lawrence River by allowing for the elimination of a certain number of stations. (Sims-ISWS)
W80-03955

ANALYSIS OF NEVADA SURFACE WATERS FOR PATHOGENIC AMOEBAE AS INDICATORS OF THERMAL POLLUTION,
Nevada Univ., Reno. Desert Research Inst.
J. Thomford, and R. Mead.
Available from the National Technical Information Service, Springfield, VA 22161 as PB80-158041, Price codes: A02 in paper copy, A01 in microfiche. Publication 50015, February 1980, 23 p, 9 Tab, 24 Ref. OWRT A-092-NEV(1), 14-34-0001-9030.

Descriptors: *Water quality, *Pathogenic amoebae, *Thermal pollution, Water analysis, Indicators, Bioindicators, Nevada, Truckee River(Nev), Carson River(Nev).

Two major rivers in northwestern Nevada, the Truckee and Carson, were examined for the occurrence of the potentially pathogenic, free-living amoebae, Naegleria fowleri, Acanthamoeba culbertsoni and A. rhysodes, for a period of one year. Water quality was also monitored. A. rhysodes and a strain believed to be intermediate to N. gruberi and N. fowleri were isolated and identified. Presence of the recovered N. fowleri strain and A. rhysodes was compared to water temperature in an attempt to determine whether the presence of either of these species might be utilized as an indication of thermal pollution.
W80-03960

ICHTHYOPLANKTON OF THE ST. LAWRENCE ESTUARY: COMPOSITION, DISTRIBUTION, AND ABUNDANCE,
Rutgers - The State Univ., New Brunswick, NJ. Dept. of Zoology.
For primary bibliographic entry see Field 2H.
W80-03965

ANALYTICAL METHOD FOR NONIONIC SURFACTANTS IN LABORATORY BIODEGRADATION AND ENVIRONMENTAL STUDIES,
Soap and Detergent Association, New York.
S. L. Boyer, K. F. Guin, R. M. Kelley, M. L. Mausner, and H. F. Robinson.
Environmental Science & Technology, Vol 11, No 13, p 1167-1171, December 1977. 2 Fig, 5 Tab, 12 Ref.

Descriptors: *Water chemistry, *Analytical techniques, *Biodegradation, *Surfactants, *Foaming, Detergents, Water quality, Laboratory tests, Ion exchange, Colorimetry, Methodology, Foam fractionation, Foam separation, Chemicals, Chemical degradation, Measurement, Evaluation, Testing procedures, Water analysis, Quality control.

For biodegradation studies, the measurement of cobalt thiocyanate active substances (CTAS) is recommended along with sublation; for environmental studies, an improved sublation procedure, ion exchange and CTAS measurement are recommended. Of the colometric techniques, cobalt thiocyanate measurements are successfully applied to biodegradation and environmental studies. Nonionic surfactants are determined by complexation with cobalt thiocyanate and subsequent colorimetry. Simplicity and fast operation make it an attractive alternative to bismuth potentiometric measurements. The 1972 Wickbold methods (DAS) for trace nonionic surfactant levels involves nonionic isolation by foaming. The Wickbold sublation procedure is an effective and relatively simple concentration step for surface active agents; however, in environmental samples, ion-exchange separation must take place after sublation. CTAS and Wickbold's procedure, or bismuth potentiometric measurements, yield comparable analytical data, allowing mutual acceptance of data collected by either method and providing a proven alternative method. CTAS and DAS comparability for environmental monitoring was established consensually among six laboratories. Light and heavy solids from sewage influent were investigated. Interlaboratory relative standard deviations were 11% for the light solids solution and 16% for the heavy solids solution. Nonionic recovery was 90% with four sublations. (Danovich-Wisconsin)
W80-03976

FUNDAMENTAL STUDIES ON THE INFLUENCE OF OIL POLLUTION UPON MARINE ORGANISMS--V THE TOXICITY OF THE GELLING COMPOUNDS FOR PETROLEUM TO MARINE ORGANISMS (IN JAPANESE),
Tokyo Univ. (Japan). Dept. of Fisheries.
H. Tokuda.
Bulletin of the Japanese Society of Scientific Fisheries, Vol 45, No 11, p 1385-1387, 1979. 3 Tab, 7 Ref, (English Summary).

Descriptors: *Toxicity, *Organic compounds, *Oil pollution, Diatoms, Marine fish, Mortality, Lethal limit, Bioassay, Oil, Growth rates, *Gelling compounds.

The toxicity of two products (abbrev. A and B) of the gelling compounds used to solidify petroleum was assayed for a marine diatom, Skeletonema costatum, and a rice fish, Oryzias Patipes, which had been previously acclimated to sea water. The following results were obtained: the lethal amounts of A and B to the diatom are more than 1,000 mg/l and 560 mg/l respectively, when A and B are separately added to the culture medium; the 24-h LA50 (which means the lethal amount of the gelling compound to 50% of the test organisms in 24 hours) of A and B to the fish are 7,400 mg/l and 4,700 mg/l respectively, when A and B are separately added to the test sea water; the filtrate of the culture medium or the sea water containing A or B is far less toxic to these test organisms. (Deal-EIS)
W80-03981

HEAVY METAL TOLERANCE OF MARINE PHYTOPLANKTON. IV. COMBINED EFFECT OF ZINC AND CADMIUM ON GROWTH AND UPTAKE IN SOME MARINE DIATOMS,
Trondheim Univ. (Norway). Inst. of Marine Biochemistry.
G. S. Braek, D. Malnes, and A. Jensen.
Journal of Experimental Marine Biology and Ecology, Vol 42, p 39-54, 1980. 11 Fig, 5 Tab, 17 Ref.

Descriptors: *Zinc, *Cadmium, *Diatoms, *Absorption, Toxicity, Heavy metals, Growth rates, Sorption, Phytoplankton, Path of pollutants, Metabolism, Magnesium.

Combinations of zinc and cadmium ions acted synergistically on the growth of the marine diatoms Thalassiosira pseudonana and Skeletonema costatum. Mixtures of the metals behaved less than additively on Phaeodactylum tricornutum and antagonistically on Skeletonema costatum. Sorption studies supported the hypothesis that the two latter algae gained their relative resistance to heavy metal ions from competition for uptake sites by the zinc and cadmium species involved. In the more resistant alga, Phacodactylum tricornutum, the sorption of cadmium and zinc was also dependent on the magnesium concentration of the medium, in a way which indicated a common uptake route for several divalent cations in this species. Cadmium was found to be more toxic than zinc to Skeletonema costatum and to Thalassiosira pseudonana, while zinc was slightly more toxic than cadmium to Phacodactylum tricornutum and Skeletonema costatum. (Deal-EIS)
W80-03982

THE BACTERIAL FLORA OF CERTAIN MARINE FISHES AND PRAWNS IN COCHIN WATERS IN RELATION TO THEIR ENVIRONS,
Central Inst. of Fisheries Technology, Cochin (India).
For primary bibliographic entry see Field 5C.
W80-03984

HAEMATOLOGICAL ASSESSMENT OF THE EFFECTS OF THE ANAESTHETIC MS222 IN NATURAL AND NEUTRALIZED FORM IN THREE FRESHWATER FISH SPECIES: HAEMOGLOBIN ELECTROPHORESIS, ATP LEVELS AND CORPUSCULAR FRAGILITY CURVES,
Randse Afrikaanse Univ., Johannesburg (South Africa). Dept. of Zoology.
G. L. Smit, J. Hattingh, and A. P. Burger.
Journal of Fish Biology, Vol 15, p 655-663, 1979. 2 Fig, 3 Tab, 12 Ref.

Descriptors: *Toxicity, *Fish physiology, *Organic compounds, Aquiculture, Carp, Rainbow trout, Mode of action, Electrophonesis, Chemical analysis, Freshwater Fish, Fish management, Chemical properties, *MS222, *Fish anaesthetics, *Anaesthetics, *Blood chemistry, *Tissue analysis, *Sarotherodon.

The effects of MS222 and neutralized MS222 anaesthesia on haemoglobin electrophoresis, erythrocyte adenosine triphosphate (ATP) levels and corpuscular fragility curves were studied in Cyprinus carpio, Sarotherodon mossambicus and Salmo gairdneri. Haemoglobin electrophoresis showed no significant intra-species differences in the percentage composition of the various fractions for any concentration of MS222 and neutralized MS222 used. Significant interspecies differences were, however, still observed. ATP levels showed intra- and interspecies differences ascribed to the response of the fish species to MS222-induced stress and not to actual changes in erythrocyte ATP concentrations. Differences were also observed in corpuscular fragility curves for all three species when using MS222 or neutralized MS222 compared to curves obtained without the use of the anaesthetic, but the mechanisms involved are not clear. (Deal-EIS)
W80-03988

THE EFFECT OF DISSOLVED COPPER ON THE INCREASE IN LENGTH OF FOUR SPECIES OF INTERTIDAL FUCOID ALGAE,
Trondheim Univ. (Norway). Museum.
T. Stromgren.
Marine Environmental Research, Vol 3, p 5-13, 1980. 7 Fig, 14 Ref.

Descriptors: *Copper, *Toxicity, *Growth rates, *Phaeophyta, Algae, Inhibition, Heavy metals, Statistical analysis, Resistance, Length, Bioassay, Water chemistry, Aquatic plants, *Fucus, Pelvetia.

The growth of Pelvetia canaliculata, Fucus spiralis, Fucus vesiculosus and Fucus serratus is measured in various concentrations of copper (12-970 microg/litre) during a period of ten days. Significant reductions in growth were observed at 12 microg/litre of copper added for P. canaliculata and F. spiralis, at 25 microg/litre for F. serratus and at 50 microg/litre for F. vesiculosus. There is a linear relationship between the percentage reduction (z) in growth rate and the product of time (x) and concentration (y), giving the equation $z = k X x X y$. The constant k is specific and may be used as a measure of resistance capacity to copper exposure. When previous data on Ascophyllum nodosum are included the five large Fucoids in the intertidal area may be ranked as follows according to their resistance capacity: A. nodosum > F. vesiculosus > P. canaliculata APPROX. F. spiralis > F. serratus. (Deal-EIS)
W80-03992

MECHANISMS OF REGULATION OF THE ACID-BASE BALANCE IN FISH AS THEY ADAPT TO CARBON DIOXIDE LEVELS IN AN AQUEOUS ENVIRONMENT,
Akademiya Nauk URSR, Kiev. Inst. Hidrobiologii.
V. D. Romanenko, V. A. Krisal'nyy, and N. I. Kotsar.
Hydrobiological Journal, Vol 14, No 5, p 41-47, 1978. 3 Fig, 19 Ref.

Descriptors: *Acid-base equilibrium, *Fish physiology, *Carp, *Carbon dioxide, Water chemistry, Electrolytes, Ions, Potassium, Sodium, Chlorine, Bicarbonates, Hydrogen ion concentration, Animal metabolism, Biochemistry, *Buffers, *Tissue analysis.

In a series of experiments on carp subjected to high C02 levels, changes were determined in inorganic ion exchange (HC03-, C1-, K+, Na+, Ca2(+) and Mg2(+)) as the acid-base balance shifted in the presence of excess C02. A study was made of the dynamics of these ions, their distribution in tissues, and their elimination. It was established that while the concentration of a given ion (HC03-, C1-) changes, there is a decline in the concentration of bases as a result of their removal from tissues and bone, and perhaps an increase in the reabsorption of some elements by the kidneys. (Deal-EIS)
W80-03994

CHANGES IN THE PHYSIOLOGICAL PROCESSES OF AQUATIC ORGANISMS UNDER THE INFLUENCE OF A CONSTANT MAGNETIC FIELD,
Institute of Biology of Southern Seas, Sevastopol (USSR).
A. I. Taneyeva.
Hydrobiological Journal, Vol 14, No 5, p 48-54, 1978. 1 Fig, 5 Tab, 24 Ref.

Descriptors: *Growth rates, *Brine shrimp, *Magnetic studies, Animal physiology, Larval growth stage, Crustaceans, Oxygen requirements, Copepods, Animal metabolism, Respiration, Length, Weight, *Magnetic fields.

A uniform magnetic field speeds the hatching and growth of larvae of A. salina, but depresses oxygen absorption in growing crustaceans. There is less dry weight per unit of length in larvae emerging in a magnetic field that in those growing outside a magnetic field. At different intensities of the magnetic field, the 'magnetic sensitivity' of the animals is stronger in a uniform field than in a non-uniform one. An increase in the water content in the bodies of the crustacea changes their 'magnetic sensitivity'. (Deal-EIS)
W80-03995

CHANGES IN BIOCHEMISTRY OF SOME AQUATIC ORGANISMS OF THE BARENTS SEA COAST IN EXPERIMENTAL OIL INTOXICATION,
Institute of the Biology of Southern Seas, Sevastopol (USSR).
I. A. Divavin, and V. Y. Yerokhin.
Hydrobiological Journal, Vol 14, No 5, p 63-66, 1978. 1 Fig, 2 Tab, 8 Ref.

Descriptors: *Biochemistry, *Phaeophyta, *Invertebrates, Oil spills, Water pollution effects, Oil, Toxicity, Mode of action, Proteins, Mussels,

Chemical analysis, Metabolism, *Tissue analysis, *DNA, *RNA, *Nucleotides.

The content of protein, free nucleotides, RNA and DNA is determined in tissues of three species of brown algae and in four species of invertebrates. A comparison of control values with those obtained during oil intoxication showed that the oil induces uncoordinated changes in the biochemical compounds. (Deal-EIS)
W80-03996

KINETICS OF ACCUMULATION OF SOME RADIONUCLIDES BY MARINE BACTERIA,
Institute of Biology of the Southern Seas, Sevastopol (USSR).
G. G. Polikarpov, A. Y. Zesenko, and A. V. Parkhomenko.
Hydrobiological Journal, Vol 14, No 5, p 67-72, 1978. 5 Fig, 13 Ref.

Descriptors: *Radioisotopes, *Sorption, *Aquatic bacteria, Cesium radioisotopes, Strontium radioisotopes, Potassium radioisotopes, Zinc radioisotopes, Bacteria, Filters, Chemical properties, Radiochemical analysis, Tracers, *Bioaccumulation, *Calcium radioisotopes.

Sorption of 137Cs, 90Sr, 32P and 45Ca on membrane filters and kinetics of their accumulation in Bacterium halophilum and B. album were studied. Sorption of the first three elements proved to depend on the dry mass of the filters. No such a dependence was observed for 45Ca. The radionuclides accumulated in B. halophilum at concentration factors (per unit dry mass of bacteria) of the order of tens (137Cs), hundreds (65Zn) and tens of thousands (32P) units. Kinetics of 137Cs, 90Sr, 45Ca, 65Zn and 32P accumulation by B. halophilum culture were traced in the course of its development in a closed volume, as were the kinetics of accumulation and excretion of 137Cs by cells of a resting B. album culture. Equilibrium accumulation of 137Cs by cells of a resting culture of B. album is achieved in 90 minutes after the start of the experiment, and half of this nuclide is excreted in 40 minutes. (Deal-EIS)
W80-03997

BASELINE STUDY OF THE LEVEL OF CONCENTRATION OF MERCURY IN THE FOOD FISHES OF BAY OF BENGAL, ARABIAN SEA AND INDIAN OCEAN,
Marine Products Export Development Authority, Cochin (India). Inspection Lab.
V. D. Ramamurthy.
Bulletin of the Japanese Society of Scientific Fisheries, Vol 45, No 11, p 1405-1407, 1979. 2 Fig, 2 Tab, 6 Ref.

Descriptors: *Mercury, *Baseline studies, *Indian Ocean, Heavy metals, Marine fish, Mollusks, Crustaceans, Sampling, Water quality, Standards, Mediterranean Sea, Atlantic Ocean, Pacific Ocean, Path of pollutants, Fish physiology, *Bay of Bengal, Arabian Sea.

Mercury levels in 18 groups of fishes including Mollusca and Crustacea were analysed. The mercury content in all the 18 groups was very low. Differential variation among different groups was also noticed where the mean average value ranges from 5 microg/kg to 65 microg/kg. The levels of concentration of mercury in some of the known food fishes of the Indian Ocean, Bay of Bengal and Arabian Sea have been compared with similar species found in the Mediterranean, Atlantic and Pacific Oceans. It was observed that the mercury content in Mediterranean and Atlantic Ocean species is 2-4 times that of the Indian Ocean species. The present values were also compared with permissible levels of mercury content of different countries. (Deal-EIS)
W80-03999

ROLES OF FOOD AND SEA WATER IN THE ACCUMULATION OF RADIONUCLIDES BY MARINE FISH,
National Inst. of Radiological Sciences, Nakaminato (Japan). Div. of Marine Radioecology.
Y. Suzuki, M. Nakahara, R. Nakamura, and T. Ueda.
Bulletin of the Japanese Society of Scientific Fisheries, Vol 45, No 11, p 1409-1416, 1979. 3 Fig, 8 Tab, 16 Ref.

Descriptors: *Radioisotopes, *Absorption, *Marine fish, Cesium radioisotopes, Zinc radioisotopes, Cobalt radioisotopes, Strontium radioisotopes, Radiochemical analysis, Tracers, Path of pollutants, Fish physiology, Animal metabolism, Water chemistry, Fish food organisms, *Bioaccumulation, *Tissue analysis, *Yellowtail, *Seriola, *Manganese radioisotopes, *Praseodymium radioisotopes, *Rhodium radioisotopes, *Ruthenium radioisotopes.

In the present work yellowtail were labelled by multiple radioisotopes (144Ce-144Pr, 106Ru-106Rh, 85Sr, 137Cs, 54Mn, 65An and 60Co) through water and food, and the radioactivity of each tracer in the tissues or organs of the fish was determined by simultaneous measurement with a Ge (Li) spectrometer. Somewhat different distribution patterns of radionuclides were found in the whole bodies of the fish at the maximum accumulation with the difference in pathways. The results showed that (1) food rather than water supplied most of the 65Zn and 54Mn accumulated by fish, (2) 85Sr and 106Ru-106Rh were mainly accumulated via water and (3) the two pathways played almost the same role in the accumulation of 137Cs, 60Co and 144Ce-144Pr. Therefore, it is necessary to take into account these results for estimation of the extent of radioactive contamination in fish under natural marine ecosystem. (Deal-EIS)
W80-04000

ACCUMULATION AND EXCRETION OF COBALT-60 TAKEN UP FROM SEAWATER BY MARINE FISHES,
National Institute of Radiological Sciences, Nakaminato (Japan). Div. of Marine Radioecology.
M. Nakahara, S. Hirano, T. Ishii, and T. Koyanagi.
Bulletin of the Japanese Society of Scientific Fisheries, Vol 45, No 11, p 1423-1428, 1979. 2 Fig, 4 Tab, 12 Ref.

Descriptors: *Cobalt radioisotopes, *Absorption, *Marine fish, Animal metabolism, Fish physiology, Radiochemical analysis, Path of pollutants, Tracers, Sea water, Nuclear powerplants, *Bioaccumulation, *Tissue analysis.

The accumulation and excretion of 60Co taken up from seawater were observed using marine fishes to examine the radioactive pollution of marine organisms. Blood was a good reserving pool of the nuclide in the fishes. It accumulated more than 15% of the radioactivity in the whole body of the fishes reared for about 90 days in the uptake experiment. Only liver and kidney showed higher radioactivity per unit weight than blood, in the tissues and organs, and muscle showed the lowest concentration of the nuclide. The biological half-lives in muscle of sea bream, yellowtail and flounder at 15C were calculated as 38.5, 53.3 and 63.0 days, respectively. The steady state concentration factors of muscle by direct uptake of 60Co from seawater were estimated in the range from 0.3 to 1.5 among the fishes in the experiments. (Deal-EIS)
W80-04001

DEGRADATION OF THE CRUDE OIL BY ARTHROBACTER SP. (IN JAPANESE),
Kobe Univ. of Mercantile Marine (Japan). Research Inst. of Marine Cargo Transportation.
M. Hirayama, and S. Nagata.
Bulletin of the Japanese Society of Scientific Fisheries, Vol 45, No 11, p 1443-1447, 1979. 7 Fig, 15 Ref. (English Summary).

Descriptors: *Microbial degradation, *Oil, Biodegradation, Metabolism, Bacteria, Aquatic bacteria, Aromatic compounds, Chemical reactions, Chemical properties, Biochemistry, Gas chromatography, *Arthrobacter, *Crude oil.

The degradation experiment of Kuwait crude oil was carried out by using an Arthrobacter sp. strain isolated from the marine environment. From the total weight changes of oil the largest degradation period was found out to be during the first three days. From 6 to 9 days' incubation, the amount of aliphatic hydrocarbon components in crude oil decreased satisfactorily, but for polycyclic aromatic polar compounds the reverse trend was observed, i.e., increment. Such an experimental result might be considered to be the extracellular production of polar compounds produced from the metabolism of aliphatic hydrocarbon substrates. For the aromatic hydrocarbons, the ring cleavage was suggested for monocyclic ones. The bicyclic ones didn't appear to proceed such a reaction path, i.e., only occurrence of degradation for the branched alkyl chains attached to the aromatic ring. The biodegradation percentage of n-alkanes was estimated to be about 87% from the GLC analysis, but only 45% degradation was totally observed through the analysis of weight changes. These results indicate that the aliphatic hydrocarbons other than n-alkanes might be resistant to degradation by this strain. (Deal-EIS)
W80-04002

LONG-TERM EFFECTS OF WATER-SOLUBLE FRACTIONS OF KUWAIT CRUDE OIL ON THE LARVAL AND JUVENILE DEVELOPMENT OF THE MUD CRAB EURYPANOPEUS DEPRESSUS,
Delaware Univ., Lewes. Marine Studies Complex.
T. L. Cucci, and C. E. Epifanio.
Marine Biology, Vol 55, p 215-220, 1979. 5 Tab, 20 Ref.

Descriptors: *Toxicity, *Oil, *Crabs, *Growth stages, Larval growth stage, Growth rates, Crustaceans, Bioassay, Mortality, Mode of Action, Animal physiology, Animal metabolism, *Crude oil, Kuwait crude.

Larvae of the mud crab were reared in various concentrations of the water-soluble fraction of Kuwait crude oil. The 48-h TLm (median tolerance limit) for Zoea Stage I was approximately 10 ppm total dissolved hydrocarbons and that for Zoea Stage II approximately 17 ppm. Chronic toxicity of more dilute solutions (4.3 and 8.7 ppm) was assessed independently for each larval stage and for subsequent developmental stages through Crab Stage 5. In the group continuously exposed to oil from hatching, there was differential mortality relative to controls in every larval stage and increased duration of intermolt periods was observed at every stage through Crab Stage 5. Mortality in groups not exposed until larvae had reached Zoea Stages III or IV was not greater than controls, suggesting that toxicity to advanced larval stages may be related to accumulation of toxic compounds by the larvae. Neither concentration (4.3 or 8.7 ppm) of crude oil caused increased mortality among juvenile crab stages regardless of the time of initial exposure. Increased occurrence of an extra and morphologically abnormal megalopa stage was associated with exposure to the crude oil. This has not been reported before. (Deal-EIS)
W80-04004

MERCURY CONTENTS OF ZOOPLANKTON COLLECTED IN THE TROPICAL PACIFIC OCEAN,
Kumamato Univ., (Japan). Aitsu Marine Biological Station.
R. Hirota, M. Fujiki, and S. Tajima.
Bulletin of the Japanese Society of Scientific Fisheries, Vol 45, No 11, p 1449-1451, 1979. 1 Fig, 1 Tab, 9 Ref.

Descriptors: *Mercury, *Zooplankton, *Pacific Ocean, Baseline studies, Heavy metals, Water quality standards, Monitoring, Sampling, Spectrophotometry, Chemical analysis, Japan, *Tissue analysis, *Bioaccumulation, *Methylmercury.

The mercury contents of zooplankton collected at eight stations in the Tropical Pacific Ocean were measured to obtain data as a standard for an unpolluted sea. Mercury values ranged from 0.0188 to 0.1248 ppm with a mean of 0.0575 ppm. The mercury contents measured in this survey were lower

V 13/12 JE 15 80 UMI

than those of zooplankton collected in the inland sea regions of Japanese, American and European estuaries, and in the oceanic area between Hawaii and California, USA. Such results seem to suggest that the Tropical Pacific Ocean is relatively uncontaminated with mercury. (Deal-EIS)
W80-04007

SURVIVAL OF JUVENILE SPOT (LEIOSTOMUS XANTHURUS) EXPOSED TO BROMOCHLORINATED AND CHLORINATED SEWAGE IN ESTUARINE WATERS,
Virginia Inst. of Marine Sciences, Gloucester Point.
M. H. Roberts, Jr.
Marine Environmental Research, Vol 3, p 63-80, 1980. 4 Fig, 3 Tab, 30 Ref.

Descriptors: *Sewage effluents, *Toxicity, *Marine fish, Sewage treatment, Chlorination, Halogens, Bromine, Bioassay, Disinfection, Fish physiology, Juvenile growth stage, Virginia, James River(Virginia), *Spot, *Leiostomus, Newport News.

The acute toxicity of chlorinated and bromochlorinated treated sewage waste was determined with spot, Leiostomus xanthurus. The halogenated sewage waste was generated in a pilot plant located at the James River Sewage Treatment Plant, Newport News, Va. The 96h and 144h LC50's were 0.23 mg/l (measured residual) for chlorine and 0.25 mg/l (measured residual) for bromine chloride. These concentrations are considerably higher than those which would be produced by optimal halogenation rates for disinfection or maximum superhalogenation rates permitted by pilot plant equipment and normal effluent dilution rates. (Deal-EIS)
W80-04008

PHOSPHATE CHARACTERISTICS AND BIOAVAILABILITY OF SUSPENDED SEDIMENTS FROM STREAMS DRAINING INTO LAKE ERIE,
Ohio State Univ., Columbus.
For primary bibliographic entry see Field 5B.
W80-04054

PHOSPHORUS LOADING ASSOCIATED WITH HOUSING IN A RURAL WATERSHED,
Department of Agriculture, Harrow (Ontario). Research Station.
For primary bibliographic entry see Field 5B.
W80-04055

TRIAZINE RESIDUES IN SUSPENDED SOLIDS (1974-1976) AND WATER (1977) FROM THE MOUTHS OF CANADIAN STREAMS FLOWING INTO THE GREAT LAKES,
Ontario Ministry of Agriculture and Food, Guelph (Ontario). Pesticide Residue Lab.
R. Frank, G. J. Sirons, R. L. Thomas, and K. McMillan.
Journal of Great Lakes Research, Vol 5, No 2, p 131-138, 1979. 1 Fig, 5 Tab, 20 Ref.

Descriptors: *Triazine pesticides, *Suspended solids, *Runoff, *Water chemistry, *Great Lakes region, *Canada, Sampling, Chemical analysis, Pollutants, Pollutant identification, Water pollution, Water quality, Rivers, Streams, Pesticides, Organic pesticides, Organic compounds, Atrazine, Desethylatrazine, Simazine.

Forty-five suspended solids collected during 1974 and 1976 from 12 streams on the Canadian side of the Great Lakes contained no detectable residues of triazines to a limit of 0.05 microgram/gram. Of 92 stream waters sampled in July 1977, 77% contained atrazine, 52% desethylatrazine, and 28% simazine above a detectable level of 0.03 microgram/liter. Mean concentrations of these three triazines in the 92 streams were 1.6, 0.3, and 0.2 microgram/liter, respectively. The highest mean triazine residue occurred in those stream waters entering Lake Erie (4.0 microgram/liter); there was little difference in the mean concentrations of waters entering Lakes Ontario (1.1 microgram/liter), St. Clair (1.3 microgram/liter), and Huron (1.4 microgram/liter). While triazine herbicides were found entering the Great Lakes, there was no threat to water quality as defined by the objectives of the International Joint Commission. (Sims-ISWS)
W80-04056

VOLATILE CHLORO- AND CHLOROFLUOROCARBONS IN LAKE ERIE--1977 AND 1978,
National Water Research Inst., Burlington (Ontario).
K. L. E. Kaiser, and I. Valdmanis.
Journal of Great Lakes Research, Vol 5, No 2, p 160-169, 1979. 5 Fig, 3 Tab, 26 Ref.

Descriptors: *Pollutants, *Water chemistry, *Sampling, *Chemical analysis, *Lake Erie, On-site data collections, Pollutant identification, Chemicals, Analytical techniques, Data processing, Correlation analysis, Chlorofluorocarbons, Chlorocarbons, Freon, Chloroform, Carbon tetrachloride, Trichloroethylene.

Water samples from the central and eastern basins of Lake Erie were analyzed for volatile chloro- and chlorofluorocarbons for a one-week period in each of 1977 and 1978. The following contaminants were observed with mean concentrations and standard deviations in 1978 with the corresponding values for 1977 in parentheses: dichlorodifluoromethane (Freon 12) 76 + or - 38 (73 + or - 36) nanograms/liter; trichlorofluoromethane (Freon 11) 34 + or - 26 (46 + or - 40) nanograms/liter; chloroform 15 + or - 4 nanograms/liter; carbon tetrachloride 19 + or - 11 (37 + or - 20) nanograms/liter; trichloroethylene 20 + or - 13 (11 + or - 9) nanograms/liter. Except for carbon tetrachloride and trichloroethylene, the distribution patterns appear to show little correlation with each other. Chloroform concentrations were relatively uniform, however, the carbon tetrachloride and trichloroethylene concentrations appear to be point-source related with discharges along the south shore of Lake Erie. Freon 12 concentrations were generally higher in the eastern basin than in the central basin, while Freon 11 levels were high and relatively uniform throughout the study area. (Sims-ISWS)
W80-04058

WATER-QUALITY ASSESSMENT OF RATTLESNAKE CREEK WATERSHED, OHIO,
Geological Survey, Columbus, OH. Water Resources Div.
K. F. Evans, and R. L. Tobin.
Geological Survey Water-Resources Investigations 79-17 (open-file report), April 1979. 28 p, 4 Fig, 11 Tab, 19 Ref.

Descriptors: *Water quality, *Surface waters, *Watersheds(Basins), *Ohio, *Water analysis, Sampling, Sites, Chemical analysis, Nutrients, Bacteria, Dissolved oxygen, Pesticides, Evaluation, *Rattlesnake Creek watershed(Ohio).

Chemical and biological water quality in Rattlesnake Creek basin, Ohio, are evaluated. The data include field and laboratory data for eight sites during August 1976-August 1977 and summaries of earlier (1972-76) data. Streamflow was below normal during the study period. Basin waters types were calcium bicarbonate or calcium magnesium bicarbonate. Specific conductance ranged from 405 to 1,300 micromhos per centimeter. High concentrations of sodium (110-140 mg/l), nitrogen (24 mg/l as N), and phosphorus (7.8 mg/l as P) were observed during low flows downstream from domestic sewage facilities. Nonpoint sources contributed high concentrations of nitrate-nitrogen to all streams during the high flows of winter and spring. Dissolved-oxygen concentrations in the upper basin ranged from 3.2 to 18.4 mg/l. Mean saturation values of dissolved oxygen were at or near 100 percent in the lower basin. Stream pH exceeded 8.4 when dissolved-oxygen saturation was above 120 percent. Bacteria and invertebrate data suggest that moderate pollution from cultural sources may exist in the upper basin. Water quality was poorest in the sluggish flows of the upper basin but improved downstream. Increases in flow velocity and stream aeration rates, dilution, and biological activity contributed to the downstream recovery. Except for high nitrogen concentrations, water quality was best in the lower basin. (Kosco-USGS)
W80-04091

KEEP RECREATIONAL WATERS ALGAE-FREE,
CH2M/Hill, Inc., Denver, CO.
For primary bibliographic entry see Field 5G.
W80-04116

CONSUMER REGULATION OF NUTRIENT CYCLING,
Wisconsin Univ., Madison, Lab. of Limnology.
For primary bibliographic entry see Field 5B.
W80-04122

IMPACT OF NONPOINT POLLUTION CONTROL ON WESTERN LAKE SUPERIOR, RED CLAY PROJECT, FINAL REPORT: SUMMARY,
Environmental Protection Agency, Chicago. IL. Great Lakes National Program Office.
For primary bibliographic entry see Field 2J.
W80-04181

5B. Sources Of Pollution

PHOSPHORUS CYCLING IN THE CREEPING SWAMP FLOODPLAIN ECOSYSTEM AND EXPORTS FROM THE CREEPING SWAMP WATERSHED,
North Carolina Univ. at Chapel Hill.
L. A. Yarbro.
Available from the National Technical Information Service, Springfield, VA 22161 as PB80-156227. Price codes: A11 in paper copy, A01 in microfiche. PhD dissertation, (Curriculum in Ecology), December 1979. 231 p, 25 Fig, 31 Tab, 241 Ref. OWRT B-084-NC(6) and B-110-NC(2), 14-31-0001-5100, 14-34-0001-8105.

Descriptors: *Phosphorus cycling, Nutrient budget, Floodplains, Fluxes, Phosphorus retention, *Wetlands, Swamps, Ecosystems, Inflow, Discharge(Water), Phosphorus, Watersheds(Basins), *North Carolina, *Creeping Swamp(NC), Coastal plains.

Measurement of fluxes to and from a freshwater floodplain swamp ecosystem, Creeping Swamp, N.C. and from the surrounding watershed in a North Carolina coastal plain, demonstrated that the swamp floodplain and watershed budget indicated that imports and exports from fertilization and crop harvesting overwhelmed natural imports in precipitation, and exports in surface waters. The lowland location of the swamp floodplain ecosystem regulated the amount and form of phosphorus leaving the watershed in surface waters. Annual rates of exchange of filterable forms of phosphorus are extremely large compared to inputs and available stocks. This suggests that estimations are gross rather than net rates of exchange which was confirmed by comparisons of radiophosphorus-32 dynamics with changes in stable forms of phosphorus.
W80-03907

THE ENVIRONMENTAL TRANSPORT OF LEAD AND CADMIUM,
Delaware Univ., Newark. Dept. of Civil Engineering.
T. L. Willis.
Available from the National Technical Information Service, Springfield, VA 22161 as PB80-158033. Price codes: A08 in paper copy, A01 in microfiche. Master's Thesis, June 1978. 165 p, 24 Fig, 12 Tab, 101 Ref, 1 Append. OWRT B-018-DEL(1), 14-34-0001-8070.

Descriptors: *Cadmium, *Lead, *Delaware, *Air pollution, *Fallout, Water pollution, Rainfall, Surface runoff, Aerosols, Sampling, Spectrophotometry, Water pollution sources, Christina River.

Rainwater samples from five sites in or around the Christina River Basin near Newark, Delaware,

were collected and analyzed to study the transport of lead and cadmium in the area. Two possible sources of the pollutants in streamwater were tested to determine whether the lead and cadmium came from urban runoff of street pollutants from Newark or whether they came from atmospheric cleansing of aerosol pollutants by dry fallout and rainout. Metals analyses of all samples were carried out by flameless atomic absorption using a Jarrel-Ash Model 810 Atomic Absorption Unit. Lead analyses were performed at 2170A and cadmium analyses at 2288A. Most samples were analyzed for total metals while some were also analyzed for soluble metals and rainwater pH. Data on stream sediments and soil samples were also collected. Results indicated that the lead and cadmium found in streamwater came from atmospheric emissions. Two mechanisms were active in removing these elements from the atmosphere. During dry months dry fallout of lead and cadmium particles accumulated and were then washed off by the next rainstorm. During wet months the lead and cadmium were removed from the atmosphere by direct rainout and were then directly transported into the stream with runoff. Atmospheric lead concentrations were linked to traffic flow levels while atmospheric cadmium was found to have an industrial source. The stability of the metals in the soil system of the area was also examined. (Seigler-IPA)
W80-03914

NON-POINT SOURCE SEDIMENTATION STUDIES USING INFRARED REMOTE SENSING,
Maine Univ. at Orono.
R. S. Smith, and T. J. Keating.
Paper No 79-2506 presented at 1979 Winter Meeting of the American Society of Agricultural Engineers, New Orleans, Louisiana. December 11-14, 1979, 9 p, 2 Fig, 6 Ref, ASAE, St Joseph, Michigan. OWRT-A-049-ME(1).

Descriptors: *Aerial photography, Agricultural runoff, *Remote sensing, Suspended solids, Turbidity, *Path of pollutants.

A method was developed utilizing aerial photography to detect turbidity and suspended solids in a river from non-point source agricultural runoff. A waterway is calibrated for film response to its particular pollutant. Future overflights can then quantitatively determine turbidity and suspended solids content for environmental monitoring.
W80-03923

ORGANIC CARBON EXPORT FROM UPLAND AND FORESTED WETLAND WATERSHEDS,
North Carolina Univ. at Chapel Hill. Dept. of Environmental Sciences and Engineering.
P. J. Mulholland, and E. J. Kuenzler.
Limnology and Oceanography, Vol 24, No 5, p 960-966, 1979. OWRT-B-084-NC(4), 14-31-0001-5100.

Descriptors: Carbon export, Watersheds(Basins), *Swamps, Swamp drainage, Forest drainage, Runoff, Evapotranspiration, *Forest watersheds, *Drainage, *Carbon, *Wetlands, Organic compounds, North Carolina, Canada, Massachusetts, New Hampshire, British Columbia.

Export of organic carbon per unit runoff from five small eastern North Carolina watersheds with considerable swamp drainage was severalfold higher than the export rates from upland watersheds. This reflects the higher concentrations of organic carbon, especially dissolved forms, in swamp waters and is probably attributable to increased contact time between water and organic debris as well as to concentration effects of high evapotranspiration in swamps.
W80-03925

STORM TRAVEL DISTANCE CALCULATIONS FOR TOTAL PHOSPHORUS AND SUSPENDED MATERIALS IN RIVERS,
West Virginia Univ., Morgantown. Dept. of Chemical Engineering.
F. H. Verhoff, D. A. Melfi, and S. M. Yaksich.
Water Resources Research, Vol 15, No 6, p 1354-1360, December 1979. 8 Fig, 13 Ref.

Descriptors: *Phosphorus, *Suspended solids, *Storm runoff, *Model studies, Mathematical models, On-site investigations, Sampling, Rivers, Water pollution, Path of pollutants, Nutrients, Hydrographs, Runoff, Storms, Pollutants, Chemicals.

From previous work it appeared that total phosphorus is transported through rivers by a series of storm events. This paper presents a method for calculating the average distance of travel during any given storm event. The method uses the hydrograph, chemograph, and flow characteristics at a point in the river. Comparisons were made between storm events at the same station in a river, between different stations in the same river basin, and between stations in different rivers. Results showed the distance of travel is dependent upon the magnitude and duration of the storm event but not on the magnitude of the total phosphorus concentration. (Sims-ISWS)
W80-03930

A PLANNING MODEL FOR THE MANAGEMENT OF GROUNDWATER QUALITY,
Humboldt State Univ., Arcata, CA. Dept. of Environmental Resources Engineering.
For primary bibliographic entry see Field 2F.
W80-03932

PRELIMINARY OBSERVATIONS ON THE BENTHIC MACROINVERTEBRATE COMMUNITIES OF ROSS BAY, A POLLUTED AREA OF LOUGH LEANE, SOUTH-WEST IRELAND,
University Coll., Dublin (Ireland). Dept. of Zoology.
E. J. Wise, and A. O'Sullivan.
Water Research, Vol 14, No 1, p 1-13, 1980. 4 Fig, 4 Tab, 41 Ref.

Descriptors: *Bays, *Lakes, *Benthos, *Biological communities, Water quality, Water pollution effects, Water pollution sources, Biota, Aquatic life, On-site investigations, Water properties, Chemical properties, Physical properties, Biomass, Euphotic zone, Littoral, Foreign research, Analysis, Sampling, Laboratory tests, Ecosystems, Algae, *Ireland, *Ross Bay(Ireland), Microinvertebrates.

The physical, chemical, and biological water quality characteristics of Ross Bay, monitored during the period July 1974-May 1975, were described. The benthic macroinvertebrate standing crop of the littoral zone was sampled quantitatively during July 1974. The results were described in terms of biomass distribution and the distribution of taxa. The sampling stations were placed in an ordinal series based on their respective pollutional status. Changes in community structure and taxonomic composition along the series were described in terms of species diversity and the distribution of 'indicator' organisms. Based on this distribution, a scheme of biotic indices was devised in order to reduce complex community composition to simple numerical terms. For this purpose, individual organisms were given a water quality rating which is dependent on their relative tolerance or intolerance to pollution. Significant correlation was shown between the ordinal series, water quality, Diversity Index values, Community Similarity values, and Biotic Quality values. The biological evaluation of water quality in lakes was discussed, and it was suggested that the littoral benthos may serve in any future assessment of organic pollution and enrichment in Lough Leane. (Humphreys-ISWS)
W80-03934

USE OF HYPOLIMNETIC OXYGEN DEPLETION RATE AS A TROPHIC STATE INDEX FOR LAKES,
Meta Systems, Inc., Cambridge, MA.
For primary bibliographic entry see Field 2H.
W80-03954

CHARACTERIZATION OF THE WATER QUALITY IN THE SAINT LAWRENCE RIVER: DETERMINATION OF HOMOGENEOUS ZONES BY CORRESPONDENCE ANALYSIS,
Institut National de la Recherche Scientifique, Rimouski (Quebec).
For primary bibliographic entry see Field 5A.
W80-03955

MODELING GROUNDWATER FLOW FIELDS CONTAINING POINT SINGULARITIES: STREAMLINES, TRAVEL TIMES, AND BREAKTHROUGH CURVES,
Stanford Univ., CA. Dept. of Civil Engineering.
For primary bibliographic entry see Field 2F.
W80-03956

HYDRAULIC EVALUATION OF A MOUND SYSTEM IN MAINE,
Maine Univ. at Orono.
K. R. Marston.
Available from the National Technical Information Service, Springfield, VA 22161 as PB80-158199, Price codes: A04 in paper copy, A01 in microfiche. MS Thesis, May 1979. 70 p, 22 Fig, 2 Tab, 29 Ref. OWRT A-040-ME(3).

Descriptors: *Septic tanks, *Sewage effluents, *Waste disposal, Path of pollutants, Monitoring, Subsurface flow, Mound systems, Evaluation, Alternative sewage disposal systems, On-site waste disposal systems.

Since 1974 mound systems have been an acceptable alternative for private sewage disposal in Maine. To data, there has been little information on the success or failure or on the relative performance of mounds as they are used in Maine. The objective of this research was to obtain data concerning the movement of septic tank effluent into and through the mound to help in evaluating the performance of mound systems in Maine. Well points were used to evaluate the distribution of applied effluent to the absorption trench and a neutron moisture probe was used to determine its movement through the sand fill. The test mound was monitored for a seven month period from June, 1977 to January, 1978. The 4-inch diameter pipe used in the mound did not provide uniform distribution of septic tank effluent along the length of the absorption trench. A clogged layer had formed on the bottom of the trench toward the inlet end of the distribution pipe causing effluent to pond. Below the clogged layer (that portion of the trench with ponded effluent) infiltrating effluent flowed vertically through a zone of unsaturated sand fill and then laterally through a saturated zone at the original soil surface until it was absorbed into the more slowly permeable subsoil. At no time was effluent observed seeping out of the toe of the mound on the ground surface.
W80-03962

WOOD PULP, WATER POLLUTION, AND ADVERTISING,
California Univ., Los Angeles. Dept. of History.
For primary bibliographic entry see Field 6E.
W80-03972

OPTIMIZED ECONOMIC USE OF SLUDGE TREATMENT FACILITIES IN DURBAN,
Durban City Engineer's Dept. (South Africa).
I. E. Everitt.
Journal of the Water Pollution Control Federation, Vol 51, No 3, p 494-498, March 1979. 1 Tab, 2 Ref.

Descriptors: *Optimization, *Waste water treatment, *Sludge treatment, *Costs, *Durban(South Africa), Operations research, Sludge disposal, Operating costs, Operation and maintenance, Facilities, Equipment, Capital costs, Construction costs, Filtration, Heat treatment, Economics, Cost comparisons, Economic efficiency, Africa, South Africa.

Four wastewater treatment plants in Durban, South Africa utilize several types of specialized sludge treatment units for conditioning, dewatering and disposal. Detailed descriptions are given of the technical operations of various kinds of equipment in use, including thickeners and best treatment for

sludge conditioning, centrifuging and filter plate presses for sludge dewatering, and incinerating and subsequent disposal of digested and heat-treated sludge. Thickening and centrifuging are newer treatment alternatives developed through experiences gained in modifying and evaluating plant operation. Cost comparisons of the various processes used in Durban indicates that operating costs vary widely when full use is not made of a unit (for example, if an ancillary boiler is manned 24 hr/day but is operated only a portion of that time). Capital costs of the 21 tons/day thickeners in 1976 were R240,000 (1 R = $1.147). The 1 ton/hr centrifuge unit cost in the same year was R110,000. The 1971 costs for the 950 kg/hr multiple-hearth furnace was R250,000. (Harris-Wisconsin)
W80-03979

DDE-CONTAMINATED FISH OFF LOS ANGELES ARE SUSPECTED CAUSE IN DEATHS OF CAPTIVE MARINE BIRDS,
Southern California Coastal Water Research Project, El Segundo, CA.
For primary bibliographic entry see Field 5C.
W80-03986

KINETICS OF ACCUMULATION OF SOME RADIONUCLIDES BY MARINE BACTERIA,
Institute of Biology of the Southern Seas, Sevastopol (USSR).
For primary bibliographic entry see Field 5A.
W80-03997

BASELINE STUDY OF THE LEVEL OF CONCENTRATION OF MERCURY IN THE FOOD FISHES OF BAY OF BENGAL, ARABIAN SEA AND INDIAN OCEAN,
Marine Products Export Development Authority, Cochin (India). Inspection Lab.
For primary bibliographic entry see Field 5A.
W80-03999

ROLES OF FOOD AND SEA WATER IN THE ACCUMULATION OF RADIONUCLIDES BY MARINE FISH,
National Inst. of Radiological Sciences, Nakaminato (Japan). Div. of Marine Radioecology.
For primary bibliographic entry see Field 5A.
W80-04000

ACCUMULATION AND EXCRETION OF COBALT-60 TAKEN UP FROM SEAWATER BY MARINE FISHES,
National Institute of Radiological Sciences, Nakaminato (Japan). Div. of Marine Radioecology.
For primary bibliographic entry see Field 5A.
W80-04001

DEGRADATION OF THE CRUDE OIL BY ARTHROBACTER SP. (IN JAPANESE),
Kobe Univ. of Mercantile Marine (Japan). Research Inst. of Marine Cargo Transportation.
For primary bibliographic entry see Field 5A.
W80-04002

ACUTE TOXICITY OF SOME EXPERIMENTAL ROAD SURFACING COMPOUNDS TO DAPHNIA PULEX,
Washington State Univ., Pullman. Dept. of Civil and Environmental Engineering.
For primary bibliographic entry see Field 5C.
W80-04003

MERCURY INTERACTION IN CRAYFISH ANTENNAL GLAND AND HEPATOPANCREAS,
Boise State Univ., ID.
R. W. Ellis, and E. G. Fuller.
Journal of Invertebrate Pathology, Vol 34, p 308-309, 1979. 4 Fig.

Descriptors: *Mercury, *Toxicity, *Crayfish, Proteins, Biochemistry, Heavy metals, Animal metabolism, Spectrophotometry, Animal physiology, Cytological studies, Invertebrates, *Tissue analysis, *Bioaccumulation, *Metallothionein.

Mercury and other heavy metals have been shown to accumulate in several aquatic invertebrates. In this study four crayfish (Pasifastacus leniusculus) were exposed for 2 days to 2.5 ppm of Hg2+. The supernatants from homogenates of antennal gland and hepatopancreas were fractionated on Sephadex G-100 columns and analyzed for Hg with an atomic absorption spectrophotometer. Mercury was present in the soluble protein fraction of the antennal gland, but not in the hepatopancreas. Two fractions from the antennal gland contained Hg2+. One, representing proteins of 100,000 to 80,000 molecular weight, contained (0.18 + or - 0.02 microg (Hg)/ml fraction) and (0.28 + or - 0.02 mg (Protein)/ml fraction) and the other, representing proteins of 15,000 to 9,000 molecular weight, contained (0.30 + or - 0.05 microg (Hg)/ml fraction) and (0.02 + or - 0.005 mg (protein)/ml fraction.) This suggests that the second fraction contains a heavy metal binding protein such as metallothionein, since all reports of this protein show it to fall within this molecular weight range. Histological changes in the structures studied are also discussed. (Deal-EIS)
W80-04006

MERCURY CONTENTS OF ZOOPLANKTON COLLECTED IN THE TROPICAL PACIFIC OCEAN,
Kumamato Univ., (Japan). Aitsu Marine Biological Station.
For primary bibliographic entry see Field 5A.
W80-04007

ON THE RESISTANCE OF ISOLATED BIVALVE GILL PIECES TO OXYGEN DEFICIENCY AND HYDROGEN SULPHIDE,
Sao Paulo Univ. (Brazil). Dept. de Fisiologia Geral.
For primary bibliographic entry see Field 5C.
W80-04009

ELEMENTAL CONTENT OF AQUATIC ORGANISMS INHABITING A POND CONTAMINATED WITH COAL FLY ASH,
Virginia Polytechnic Inst. and State Univ., Blacksburg. Office of Occupational Health and Safety.
A. K. Furr, T. F. Parkinson, W. D. Youngs, C. O. Berg, and W. H. Gutenmann.
New York Fish and Game Journal, Vol 26, No 2, p 154-161, 1979. 3 Tab, 15 Ref.

Descriptors: *Industrial wastes, *Absorption, *Aquatic life, Electric powerplants, Coals, Ponds, Path of pollutants, Aquatic algae, Aquatic plants, Aquatic insects, Amphibians, Freshwater fish, Rodents, Sediments, *Aluminum, Chlorine, *Zinc, *Chromium, *Copper, Metals, Heavy metals, Trace elements, *Coal fly ash, *Selenium, *Tissue analysis, *Bioaccumulation, *Arsenic.

Using neutron activation and other methods, 39 elements were determined in algae, aquatic weeds, dragonfly nymphs, polliwogs, red-spotted newts, bullheads and muskrats from a pond contaminated by coal fly ash. The organisms contained several elements, including selenium, at concentrations markedly higher than those in controls. (Deal-EIS)
W80-04011

STUDIES ON CHEMOTHERAPY OF FISH DISEASES WITH PIROMIDIC ACID--I. ABSORPTION, DISTRIBUTION, EXCRETION AND TOXICITY OF PIROMIDIC ACID IN SOME SPECIES OF FISHES,
Dainippon Pharmaceutical Co. Ltd. (Japan) Research Lab.
H. Katae, K. Kouno, S. Morikawa, F. Tashiro, and S. Takahashi.
Fish Pathology, Vol 14, No 2, p 79-92, 1979. 1 Fig, 13 Tab, 5 Ref.

Descriptors: *Chemical properties, *Pesticides, *Fish diseases, Aquiculture, Chemical analysis, Pesticide kinetics, Pesticide residues, Absorption, Toxicity, Bioassay, Salmonids, Eels, Fish physiology, Animal metabolism, *Tissue analysis, *Ayu, *Plecoglossus, Piromidic acid, Anguilla, Pacific salmon, Oncorhynchus.

The pharmacokinetic and toxicological effects of piromidic acid (PA, 8-ethyl-5, 8-dihydro-5-oxo-2-pyrrolidinopyrido(2,3-d)pyrimidine-6-carboxylic acid) were studied in ayu Plecoglossus altivelis, amago salmon Oncorhynchus rhodurus and eels Anguilla japonica and A. anguilla. The absorption, distribution and excretion data obtained from the bioassay revealed that orally administered PA was easily absorbed and quickly became distributed in blood and major organs. Peak levels were reached in 3h (in ayu) or 6-24h (in amago salmon) after the administration of PA, followed by a gradual decrease. The levels of PA in liver and kidney were higher than in blood and plasma. In the acute toxicity study, the LD50 value for ayu was more than 2,000 mg/kg. The subacute toxicity of PA was studied in ayu (80 mg/kg), amago salmon (800 mg/kg) and eels (400 mg/kg) administered PA once daily for 5-10 days. Except for accidental death of two eels, all fishes receiving PA survived without any clinical and histopathological changes. Dissapearance of PA from the tissues in amago salmon was studied after the administration of 40 mg/kg PA for 7 consecutive days. Peak levels of PA in the tissues tested were attained within 6-12 h following administration. A level below the assay limits (0.25-0.56 ug/ml or g) was reached 96h post-dosing. No evidence of long term residue was found in any of the tissues tested. (Deal-EIS)
W80-04012

SOIL SUITABILITY FOR ON-SITE WASTE DISPOSAL: DEVELOPMENT OF GENETICALLY MARKED ESCHERICHIA COLI STRAINS AS TRACERS OF SUBSURFACE WATER FLOW,
Oregon State Univ., Corvallis. Water Resources Research Inst.
For primary bibliographic entry see Field 5E.
W80-04017

MULTIOBJECTIVE OPTIMIZATION IN WATER QUALITY AND LAND MANAGEMENT,
Virginia Univ., Charlottesville. Dept. of Environmental Sciences.
P. Das, and Y. Y. Haimes.
Water Resources Research, Vol 15, No 6, p 1313-1322, December 1979. 2 Fig, 5 Tab, 34 Ref. OWRT C-7047(No 6221)(8), 14-34-0001-6221.

Descriptors: *Water quality, *Water pollution sources, *Management, *Optimization, *Ohio, Model studies, Watersheds(Basins), Erosion, Soil erosion, Phosphorus, Nutrients, Biochemical oxygen demand, Dissolved oxygen, Land use, Planning, Water pollution, Pollutants, Path of pollutants, Water pollution treatment, Land resources.

A multiobjective planning framework for a river basin that considers both point and nonpoint source pollutants was presented. The need for an integrated approach to pollution abatement originating from these two sources was discussed in the light of Public Law 92-500. The need for including multiple objective functions in their noncommensurable formats and units was also discussed. Two broad-based planning objectives considered were economic development and environmental quality. The environmental quality model included the following multiple objectives: (1) soil erosion, (2) phosphorus, (3) biological oxygen demanding load in the stream. Noninferior solutions and trade-offs among the objectives were examined for several alternative planning scenarios using the surrogate worth trade-off (SWT) method. The decision-maker's role in obtaining the basin-wide plan was discussed. Finally, the planning framework was applied to the Maumee River Basin study. (Sims-ISWS)
W80-04027

ANALYTICAL SOLUTION OF A VELOCITY DEPENDENT DISPERSION PROBLEM,
Princeton Univ., NJ. Dept. of Civil Engineering.
D. H. Tang, and D. K. Babu.
Water Resources Research, Vol 15, No 6, p 1471-1478, December 1979. 7 Fig, 8 Ref, 3 Append. NSF-ENG-76-18957, NSF-ENG-78-24413.

Descriptors: *Dispersion, *Wells, *Injection wells, Steady flow, Porous media, Groundwater, Hydrology, Equations, Velocity, Path of pollutants, *Well hydraulics, Dispersion coefficient.

A complete description of the convective-dispersive transport of a contaminant from an injection well requires consideration of a velocity dependent dispersion coefficient. An analytical solution of this equation for steady fluid flow conditions can be obtained. The solution is significantly different from existing approximate analytical solutions. A numerical solution to this problem converges to the new analytical solution upon refinement of the finite difference net. (Lee-ISWS)
W80-04030

A NOTE ON DIFFUSION FROM A CONTINUOUS LINE SOURCE IN A TIME VARYING FLOW,
State Univ. of New York at Stony Brook. Marine Sciences Research Center.
R. E. Wilson.
Water Resources Research, Vol 15, No 6, p 1636-1638, December 1979. 1 Fig, 2 Ref.

Descriptors: *Diffusion, *Unsteady flow, *Model studies, Mathematical models, Currents(Water), Tidal waters, Dispersion, Solutes, Pollutants, Path of pollutants, Water pollution, Estuaries, Oscillating flow.

This note described approximate techniques for calculating the transient concentration field resulting from horizontal diffusion from a continuous source in a time varying flow. Using these techniques, calculations could be performed either by hand or very economically by machine. The analyses were based on a model for two-dimensional horizontal diffusion in which the field for a continuous source is represented as the superposition of the fields for instantaneous patches; the spread of an instantaneous patch is characterized by a diffusion velocity. The specific case considered was an oscillating flow characteristic of a tidal estuary, but the techniques should be of practical value in the description of concentration fields of passive quantities introduced into a variety of time varying flows. (Sims-ISWS)
W80-04037

A NOTE ON ERROR ANALYSIS FOR A PHOSPHORUS RETENTION MODEL,
Michigan State Univ., East Lansing. Dept. of Resource Development.
For primary bibliographic entry see Field 2H.
W80-04040

DIMENSIONALITY PROBLEMS IN WATER QUALITY NETWORK DESIGN,
Washington Univ., Seattle. Dept. of Civil Engineering.
For primary bibliographic entry see Field 7A.
W80-04041

WATER QUALITY SAMPLING: SOME STATISTICAL CONSIDERATIONS,
Johns Hopkins Univ., Baltimore, MD. Dept. of Mathematical Sciences.
For primary bibliographic entry see Field 7A.
W80-04042

NON-POINT SOURCE POLLUTION FROM ABANDONED AGRICULTURAL LAND IN THE GREAT LAKES BASIN,
Michigan State Univ. East Lansing. Dept. of Crop and Soil Sciences.
T. M. Burton, and J. E. Hook.
Journal of Great Lakes Research, Vol 5, No 2, p 99-104, 1979. 3 Tab, 21 Ref. EPA R005143-01.

Descriptors: *Water pollution sources, *Agricultural watersheds, *Great Lakes region, Sampling, Nutrients, Nitrogen, Nitrogen compounds, Phosphorus, Phosphorus compounds, Calcium, Sodium, Chlorine, Suspended solids, Runoff, Agricultural runoff, Pollutants, Water pollution, Path of pollutants, *Abandoned agricultural land, Non-pointed water pollution sources.

The contribution of abandoned farm fields to non-point source pollution in the Great Lakes Basin was studied on a 7.73 ha old field watershed near East Lansing, Michigan, that had been abandoned 18 years prior to the study. Exports of nitrogen were low and approached values expected for undisturbed forests in the Great Lakes Basin. Exports of phosphorus were slightly elevated compared to undisturbed forests. Exports and concentrations of both N and P were similar to values listed for cleared, unproductive land for the Great Lakes region by the recent nationwide survey of EPA. Annual exports of total P, P04-P, N03-N, N02-N, NH4-N, Organic-N, Cl, Na, Ca, and suspended solids were given. Most exports of all constituents occurred during rainfall or snow-melt generated runoff events during the spring runoff period. Soil and soil-water nutrient concentrations were low, reflecting the low fertility of the study watershed. Nutrient concentrations in runoff reflect this low fertility and would be higher from recently abandoned farm land. The contribution of abandoned fields to nutrient loading of the Great Lakes would decrease from levels typical of agricultural runoff at time of abandonment to levels typical of undisturbed forests within 15 to 20 years following abandonment. (Sims-ISWS)
W80-04052

PHOSPHATE CHARACTERISTICS AND BIOAVAILABILITY OF SUSPENDED SEDIMENTS FROM STREAMS DRAINING INTO LAKE ERIE,
Ohio State Univ., Columbus.
T. J. Logan, T. O. Oloya, and S. M. Yaksich.
Journal of Great Lakes Research, Vol 5, No 2, p 112-123, 1979. 2 Fig, 3 Tab, 28 Ref.

Descriptors: *Suspended solids, *Phosphorus, *Nutrients, *Lake Erie, Streams, Rivers, Sampling, Chemical analysis, Analytical techniques, Watersheds(Basins), Water chemistry, Pollutants, Water pollution, Biology, Sediments, Path of pollutants, Bioavailable phosphorus.

Suspended sediments from major U.S. tributaries draining into Lake Erie were analyzed for phosphorus. Analyses included: sediment concentration, reactive and total filtered P, and total P on water samples. Recovered sediment total P was determined by perchloric and persulfate extraction. Sediment was fractionated for NaOH-P citrate-dithionite-bicarbonate (CDB)-P, HCl-P, and organic P. New York streams had the highest suspended solids and the lowest content of most sediment fractions except HCl-P. NaOH-P and CDB-P were highest in sediments from Ohio tributaries; these fractions are considered to be bioavailable with NaOH-P more available than CDB-P. Digestion with perchloric acid consistently removed more P than the persulfate method. The difference in the two methods was negatively correlated with HCl-P. (Sims-ISWS)
W80-04054

PHOSPHORUS LOADING ASSOCIATED WITH HOUSING IN A RURAL WATERSHED,
Department of Agriculture, Harrow (Ontario). Research Station.
J. D. Gaynor.
Journal of Great Lakes Research, Vol 5, No 2, p 124-130, 1979. 2 Fig, 5 Tab, 19 Ref.

Descriptors: *Phosphorus, *Bioindicators, *Domestic wastes, *Agricultural watersheds, Rural areas, Drainage, Runoff, Watersheds(Basins), Pollutants, Water pollution, Bacteria, Coliforms, Sampling, Instrumentation, Chemical analysis, Water chemistry, Water pollution sources, Housing effects.

Phosphorus and biological indicator organisms were measured in a rural watershed to quantify housing and agricultural inputs to the drainage system. Total-P and orthophosphate-P (P04-P) were significantly higher downstream from intensive housing areas than at areas with lower housing density. Housing areas discharged 40% particulate-P and 53% P04-P, while rural areas discharged 62 and 29%, respectively. On the average, rural housing contributed 2 g P/house/day which comprised 27% of the P04-P discharged from the study area. For the rural subwatersheds, phosphorus from agriculture was not differentiated from biogeochemical and precipitation inputs. Assuming all phosphorus arose from fertilizer application, total-P losses represented 3.5% of that applied, while P04-P losses represented less than 1%. It was concluded that housing in rural areas contributes P04-P to nutrient enrichment of drainage systems and that measures to control rural erosion may reduce total-P load but increase the proportion of P04-P. (Sims-ISWS)
W80-04055

TRIAZINE RESIDUES IN SUSPENDED SOLIDS (1974-1976) AND WATER (1977) FROM THE MOUTHS OF CANADIAN STREAMS FLOWING INTO THE GREAT LAKES,
Ontario Ministry of Agriculture and Food, Guelph (Ontario). Pesticide Residue Lab.
For primary bibliographic entry see Field 5A.
W80-04056

APPLICATION OF SHORT-TIME SCALE RECORDING METER DATA TO NUMERICAL MODELLING OF TORONTO HARBOUR,
Ontario Ministry of the Environment, Toronto.
D. J. Poulton.
Journal of Great Lakes Research, Vol 5, No 2, p 144-152, 1979. 10 Fig, 1 Tab, 15 Ref.

Descriptors: *Harbors, *Water circulation, *Water quality, *Canada, *Model studies, Currents(Water), Water chemistry, Temperature, Water temperature, Conductivity, Hydrogen ion concentration, Dissolved oxygen, Dissolved solids, Winds, Sampling, Analytical techniques, *Toronto Harbour.

One of the major difficulties in time-dependent numerical modeling of Great Lakes harbors is providing adequate data to describe the variation of waste discharges and open boundaries at short-time intervals (order of minutes). Short-time scale data for currents, winds, and total dissolved solids (as measured by conductivity) have been obtained at 10-minute intervals by digital recording automated equipment located at fixed points representing major discharges and connecting channels to Lake Ontario. These data have been entered directly into a two-dimensional hydrodynamic and water quality model of Toronto Harbour. The model outputs for time periods of up to 96 h were presented in the form of vector plots of currents and contour maps of water quality. The output was validated by comparison with independent short-time scale currents and water quality data measured at an interior point within the harbor, using methods of direct plotting and least-squares analysis. It is expected that refinement of physical variables in the model and measurement of verification data at closer intervals (1 or 2 min) will improve the extent of model verification. Such a model is expected to be a powerful tool in predicting the response of water bodies to management policies such as loading changes and alteration of harbor geometry. (Sims-ISWS)
W80-04057

EASTERN GULF OF MEXICO MARINE HABITAT STUDY. VOLUME I.
Woodward-Clyde Consultants, Orange, CA.
Available from the National Technical Information Service, Springfield, VA 22161 as PB-294 152, Price codes: A06 in paper copy, A01 in microfiche. Final Report to Bureau of Land Management, January 1979. 111 p, 3 Fig, 2 Tab, 2 Append. AA551-CT8-22.

Descriptors: *Baseline studies, *Gulf of Mexico, *Florida, *Habitats, *Resources development, Environmental effects, Ecology, Water pollution sources, On-site investigations, Oil pollution, Leases, Oil fields, *Outer Continental Shelf, Environmental impact.

The primary objective of the Eastern Gulf of Mexico Marine Habitat Study was to identify and delineate marine habitat areas in 49 of the proposed lease blocks included in OCS Sale No. 65. The

lease blocks are located offshore Florida in the Gulf of Mexico. The 49 blocks were divided into 10 non-contiguous map areas for the purposes of discussion and data presentation. The ground truth and geophysical data were reviewed to identify potentially critical marine habitat areas where further studies may be desired prior to initiation of any offshore operations that could affect the marine habitat. The majority of the areas studied have a 'soft bottom'. Most of the biotic activity is associated with the soft bottom which varies considerably in character and biotic productivity. The soft bottom areas represent a prime resource and must be considered in proper perspective before any judgements about the ecological and economic impacts of the lease sale can be made. (See also W80-04077) (Sinha-OEIS)
W80-04076

EASTERN GULF OF MEXICO MARINE HABITAT STUDY. VOLUME II: MAPS AND CROSS SECTIONS.
Woodward-Clyde Consultants, Orange, CA.
Available from the National Technical Information Service, Springfield, VA 22161 as PB-294 153, Price codes: A03 in paper copy, A01 in microfiche. Final Report to Bureau of Land Management, January 1979. 28 p. AA551-CT8-22.

Descriptors: *Baseline studies, *Gulf of Mexico, *Florida, *Habitats, Resources development, On-site investigations, Leases, Oil fields, *Outer Continental Shelf, Environmental impact.

Volume 2 of the Eastern Gulf of Mexico Marine Habitat Study consists of an index map, navigation post plots, bethymetry and sea floor sediment characteristics maps, and 3 sheets of geologic cross sections. (See also W80-04076) (Sinha-OEIS)
W80-04077

EFFECTS OF LANDFILL LEACHING ON WATER QUALITY AND BIOLOGY OF A NEARBY STREAM, SOUTH CAIRO, GREENE COUNTY, NEW YORK,
Geological Survey, Albany, NY. Water Resources Div.
T. A. Ehlke.
Available from the National Technical Information Service, Springfield, VA 22161 as PB-300 776, Price codes: A02 in paper copy, A01 in microfiche. Geological Survey, Water-Resources Investigations 79-13, 1979. 18 p, 2 Fig, 3 Tab, 11 Ref.

Descriptors: *Landfills, *Leachate, *Infiltration, *Water quality, *Waste disposal, *Biology, Streamflow, New York, Reach(Streams), Analytical techniques, Chemical analysis, Documentation, Observation wells, Sampling, Data collections, Groundwater, Surface waters, Benthic fauna, Invertebrates, Aquatic populations, Microorganisms, Inflow, Heavy metals, Algae, Bacteria, Path of pollutants, *Greene County(NY), Bell Brook.

A 1-kilometer stream reach receiving leachate-enriched water from a small municipal landfill in Greene County, N.Y., was studied from 1971-75 to document streamflow rates and chemical quality of the stream and ground water. The distribution of benthic invertebrates and microorganisms in the stream above the landfill was markedly different from that below it; the difference is attributed to the inflow of leachate. The Trichoptera, Ephemeroptera, and Nematomorpha have been eliminated from the reach adjacent to and below the landfill and have been replaced by large numbers of Tendipedidae and Niadidae. Certain chemical constituents, especially iron and manganese, were extremely concentrated in the ground water immediately beneath the streambed. The elevated concentrations of these and other metals may be the direct cause of the abrupt faunal shift. Algae were replaced by large masses of the iron bacterium Leptothrix in the stream reach below the landfill. (Kosco-USGS)
W80-04092

STATISTICAL ANALYSIS OF NITRATE CONCENTRATIONS FROM THE RIVER FROME (DORSET) FOR THE PERIOD 1965-76,
Freshwater Biological Association, Wareham (England). River Lab.
H. Casey, and R. T. Clarke.
Freshwater Biology, Vol 9, No 2, p 91-97, April 1979. 6 Fig, 7 Tab, 15 Ref.

Descriptors: *Nitrates, *River Frome(UK), United Kingdom, *Statistics, Statistical methods, Regression analysis, Discharge(Water), Correlation analysis, Seasonal, Annual, Cycling nutrients, River flow.

Model predictions for 1976 nitrate concentrations (mean 3.37 mg) in the River Frome, England, based on 11 years (1965-1975) weekly data of nitrate concentrations and discharge values, were very close to the 3.44 mg observed mean nitrate concentrations. 1976 results showed 1.5 mg nitrate minimum concentration in August, followed by 7.24 mg concentration only seven weeks later. The model poorly fit seasonal 1976 variation due to a dry preceding winter, summer drought until September, and heavy rainfall in early winter. Data from 1965-1975 showed weekly mean peaks in early February, low values in summer and high values in winter, following a cosine wave. 84% of yearly mean variation is explained by a linear regression on time. A 0.107 regression coefficient estimates average annual increase in nitrate concentration between 1965-1975. No overall trend occurred in flow rates over the years, although mean annual 1966-1968 flows were significantly higher than other years. Although discharge closely relates to seasonal nitrate variation when based on weekly data averaged over several years, individual discharges and nitrate concentrations relate less closely because both vary considerably and independently over one week. Nitrate was determined by the phenol disulphonic acid method. (Danovich-Wisconsin)
W80-04101

CCE-M VALUES OF NATURAL AND RECHARGED GROUNDWATERS,
Arizona Univ., Tucson. Dept. of Civil Engineering and Engineering Mechanics.
K. L. Knickerbocker.
Available from the National Technical Information Service, Springfield, VA 22161 as PB80-160856, Price codes: A05 in paper copy, A01 in microfiche. M.S. Report, 1976. 68 p, 6 Fig, 8 Tab, 31 Ref. OWRT A-067-ARIZ(2), 14-34-0001-6003.

Descriptors: *Water quality, *Groundwater, *Waste water(Pollution), *Reclaimed water, *Groundwater recharge, Organic compounds, Trace elements, Dissolved solids, Public health, Water wells, Potable water, Standards, CCE-m, Groundwater organics, Wastewater recharge, Groundwater quality.

The total organic content or recharged secondary effluents as measured by the miniaturized carbon chloroform extract method (CCE-m) was investigated by analyzing waters from wells located at various distances from recharge areas. It was found that the CCE-m organic concentration decreased with increasing percolation distance. Secondary activated sludge effluent was found to contain 3.80 mg/l CCE-m. Percolation through 100 feet of porous media reduced the CCE-m value to less than 0.50 mg/l. This is less than the E.P.A. proposed 1974 Drinking Water Standard of 0.70 mg/l. Fourteen wells located a minimum of 1,000 feet from an ephemeral stream receiving secondary effluent had CCE-m values less than 0.20 mg/l. A general survey of deep wells known not to receive any wastewater recharge found CCE-m values varying from 0.04 to 0.30 mg/l. It is probable that the oil lubrication methods employed in deep wells resulted in these CCE-m values.
W80-04110

SEASONAL VARIATION IN THE POPULATIONS OF MOINA MACROCOPA STRAUSS AND MOINA MICRURA KURZ (CRUSTACEA: CLADOCERA) IN ZOAFARANIYAH POOLS,
Biological Research Centre, Baghdad (Iraq).
A. N. Khalaf, and A. F. Shihab.
Hydrobiologia, Vol 62, No 1, p 75-77, January 1979. 2 Tab, 9 Ref.

Descriptors: *Crustaceans, *Seasonal, *Population dynamics, *Reproduction, *Zoafaraniyah pools, Iraq, Invertebrates, Population, Water temperature, Temperature, Physiochemical properties, Speciation, Animal behavior, Animal physiology, Animal metabolism, Life history studies, Life cycles, On-site investigations.

A clear difference exists between two cladoceran species in Zoafaraniyah pools, Iraq, as measured in July 1976-June 1977; Moina macrocopa has one developmental cycle, whereas Moina micrura has a cicyclic development. Both species reach a maximum in October when temperatures are 22-28.5C. M. macrocopa density reaches 11,815/l. During winter months population density gradually declines to 73/l in December. M. micrura population peaks in October and April, amounting to 13,125/l and 11,000/l, respectively. Both species completely disappear in January when temperatures are 4-9C. However, M. micrura occurs in the field five to six months earlier than M. macrocopa does. Reproduction does not occur for either species in July, indicating a response to high temperatures. M. macrocopa reproduction takes place September-December while M. micrura reproduction occurs March-July and August-December. (Danovich-Wisconsin)
W80-04121

CONSUMER REGULATION OF NUTRIENT CYCLING,
Wisconsin Univ., Madison, Lab. of Limnology.
J. F. Kitchell, R. V. O'Neill, D. Webb, G. W. Gallepp, and S. M. Bartell.
BioScience, Vol 29, No 1, p 28-34, January 1979. 5 Fig, 2 Tab, 82 Ref. NSF AG-199, ERDA BMS 76-00761.

Descriptors: *Cycling nutrients, *Secondary productivity, *Translocation, *Animal behavior, *Food habits, Nutrients, Ecosystems, Distribution, Vertical migration, Fish, Biomass, Insects, Biological communities, Sediment-water interfaces, Mixing, Energy budget, Food chains, Cycles, Aquatic productivity, Predation, Zooplankton.

Nutrient-cycling rates in ecosystems are altered by translocation and transformation which result from consumer organism behavior and consumption processes. Consumers have been simply represented as components in energy-flow patterns; however, they substantially influence nutrient cycling through physical/chemical processes, mainly by translocation and transformation. Consumer translocation is an important ecosystem-level process because animal mobility and behavior affect nutrient redistribution across subsystem boundaries. Diel vertical migration by zooplankton causes rapid nutrient translocation. In aquatic systems, fish represent the most mobile form of phosphorus and concentrate the mineral four-fold over other biomass pools. Nutrient cycling due to biological distrubance at sediment-water interfaces is great because massive phosphorus pools are stored in sediments. Over time, consumers transform the surface/volume relationship of their prey community or food substrate in ways that alter nutrient cycling processes. In aquatic ecosystems, selective predation alters the size spectrum of particles. The keystone role of soil arthropods in litter transformation involves comminution, or reduction in particle size. In decomposing tree boles, channelization by termites, ants and beetles, significantly transforms physical/chemical processes. Small units are also aggregated such as in macroarthropod feces or fish biomass, resulting in nutrient conservation. (Danovich-Wisconsin)
W80-04122

APPLYING PHOSPHORUS LOADING MODELS TO EMBAYMENTS,
National Oceanic and Atmospheric Administration, Ann Arbor, MI. Great Lakes Environmental Research Lab.
S. C. Chapra.
Limnology and Oceanography, Vol 24, No 1, p 163-168, January 1979. 2 Fig, 1 Tab, 20 Ref.

Descriptors: *Saginaw Bay, *Bays, *Phosphorus, *Cycling nutrients, *Model studies, *Turbulent

flow, Lake Huron, Great Lakes, Gulfs, Inlets, Eutrophication, Sounds, Vollenweider models, Mixing, Advection, Nutrient loading, Nutrients, Nutrient transport, Mathematical models, Turbulence, Nutrient budgets.

Most phosphorus loading models have been applied to lakes where advection through river outlets is the predominant form of mass transport out of the system. This paper develops a simple loading model for bays which can be considered as completely mixed systems when a turbulent mass transport term is added to a nutrient budget equation. The model is demonstrated for use with Saginaw Bay, Lake Huron. A method is devised to incorporate turbulent diffusion into loading plots by adjusting loading terms to include phosphorus flux from Lake Huron into the bay and including turbulent flow effects in residence time. Physical and chemical data for the system (Saginaw Bay, its tributaries and Lake Huron) as measured during 1974-76 are utilized in an equation to yield a bulk diffusion coefficient. Calculation of total phosphorus concentration requires an estimate of apparent settling velocity, estimated here at 12.4 m/yr as derived from phosphorus budget data from a number of other lakes. On the basis of calculations employing the suggested model, a total phosphorus budget is given: of an estimated 1,443 t/yr coming into the bay from direct loadings and tributaries, 38% is incorporated into the sediments, 16% leaves by advection, and 46% leaves by turbulent mixing; thus, inclusion of the turbulent mixing process in the loading model accounts for nearly half the phosphorus outflow from Saginaw Bay. (Harris-Wisconsin)
W80-04123

DISTRIBUTION OF POLLUTANTS FROM A NEW PAPER PLANT IN SOUTHERN LAKE CHAMPLAIN, VERMONT AND NEW YORK,
Michigan Univ., Ann Arbor. Dept. of Natural Resources.
D. L. Mason, D. W. Folger, R. S. Haupt, R. R. McGirr, and W. H. Hoyt.
Environmental Geology, Vol 1, No 6, p 341-347, May 1977. 3 Fig, 2 Tab, 23 Ref.

Descriptors: *Lake Champlain, *Pulp and paper industry, *Pollutant identification, *Pulp wastes, *Sediments, Pollutants, Suspended load, Suspended solids, Sediment discharge, Water pollution sources, Water pollution treatment, Lake beds, Phosphorus, Wood wastes, Organic wastes, Carbon, Kaolinite, Organic loading, Water pollution effects.

Water column and bottom sediments collected November 1973-May 1974 near the outfall of a new paper plant located on Lake Champlain's western shore and opened in June 1971 contained measurable quantities of components derived from the pulp and paper mill despite extensive treatment to reduce such pollutants. Recovered detritus and near-bottom sediments were analyzed for materials used in paper manufacturing, such as kaolinite (paper filler), anatase (paper whitener), organic carbon (derived from wood fibers) and phosphorus (added in treatment processes). As much as 2.3 cm of sediment accumulated during the six-month monitoring period near the new mill outfall whereas less than 1 cm accumulated in all other areas sampled. Kaolinite/chlorite values in trap sediments were highest (1.4%) at the plant outfall as well as anatase concentrations (0.8%). Organic carbon concentrations were highest in both traps (8.7%) and bottom sediments (4.2%) near the mili outfall. Similarly, extractable phosphorus concentrations in trap sediments (254 micro g/g) and bottom sediments (127 micro g/g) were highest near the outfall. All values for these components remained high 1.5-6 km to the north. Values were significantly lower in most other areas sampled in southern Lake Champlain. Extensive primary and secondary waste treatment facilities including tanks, lagoons and clarifers were constructed to process the 62,000 cu m daily wastewater discharge; however, additional effluent treatment is still necessary. (Danovich-Wisconsin)
W80-04126

PLANNING FOR NONPOINT POLLUTION CONTROL IN NORTH CAROLINA,
Soil Conservation Service, Raleigh, NC.
L. A. Brown.
Journal of Soil and Water Conservation, Vol 34, No 1, p 8-10, January-February 1979. 2 Tab, 5 Ref.

Descriptors: *North Carolina, *Nonpoint pollution, *Planning, *Agricultural runoff, *Erosion control, *Federal Water Pollution Control Act Amendments of 1972, Erosion, Water quality, Soil erosion, Water pollution, Water pollution sources, Water pollution control, Soil conservation, Costs, Erosion rates, Farms, Agriculture, Soil management, Federal Water Pollution Control Act.

Responsibility for nonpoint pollution control program planning on agricultural land in North Carolina was delegated to the Soil and Water Conservation Commission, which coordinates the Agricultural 208 Planning Group. The 208 Planning Group developed a three-phase study plan. As part of Phase I, a statewide inventory of erosion was conducted for different land uses. During Phase II, sub-basins with high pollution potential were investigated to determine which nonpoint pollutants were present, their source and the best management practices (BMPs) needed to control them. Phase III involved continued study and monitoring of two priority sub-basins. Highest erosion rates occur on surface mines, sanitary landfills, construction sites and shorelines; however, almost two-thirds of the state soil loss occurs from cropland. The highest sediment delivery rates occur in the Piedmont and mountain state areas. Almost half of the erosion occurs on 2.3 million acres of high water erosion hazard cropland. This means that over 36 million tons of the state's annual soil loss of 79 million tons comes from 7.4% of the land. The proposed multi-year program includes BMPs to reduce erosion on cropland to 5 tons/acre/yr. Installing and maintaining these BMPs will cost an estimated $281 million as of October 1978. On-site costs of installing these practices average $75/acre. North Carolina landowners now spend $9 million/yr to install erosion and sediment control practices. Even with active cost-sharing government programs, less than half the needed $28 million/yr is being provided. (Danovich-Wisconsin)
W80-04130

PHOSPHATASE ACTIVITY AND ITS ROLE IN THE MINERALIZATION OF ORGANIC PHOSPHORUS IN COASTAL SEA WATER,
Tokyo Univ. (Japan). Ocean Research Inst.
For primary bibliographic entry see Field 5F.
W80-04141

MARS - A NEW INSTRUMENT FOR MEASURING PHYTOPLANKTON SINKING RATE,
Oceanic Inst., Waimanalo, HI.
For primary bibliographic entry see Field 7B.
W80-04142

THE ECOSYSTEM APPROACH; SCOPE AND IMPLICATIONS OF AN ECOSYSTEM APPROACH TO TRANSBOUNDARY PROBLEMS IN THE GREAT LAKES BASIN.
International Joint Commission-United States and Canada, Windsor (Ontario). Great Lakes Science Advisory Board.
For primary bibliographic entry see Field 6E.
W80-04159

5C. Effects Of Pollution

ORGANIC CARBON CYCLING IN A SWAMP-STREAM ECOSYSTEM AND EXPORT BY STREAMS IN EASTERN NORTH CAROLINA,
North Carolina Univ. at Chapel Hill. Dept. of Environmental Sciences and Engineering.
P. J. Mulholland.
Available from the National Technical Information Service, Springfield, VA 22161 as PB80-160658, Price codes: A08 in paper copy, A01 in microfiche. Ph.D Dissertation, 1979. 152 p, 31 Fig, 37 Tab. OWRT B-084-NC(5) and B-110-NC(1), 14-31-0001-5100, 14-34-0001-8105.

Descriptors: Organic carbon concentration, Organic carbon flux, Carbon export, Organic carbon budget, Swamp ecosystem, Biological inputs, Biological outputs, Streams, Hydrologic inputs, Hydrologic outputs, Channelized streams, *Swamps, *Carbon, *Organic compounds, *Ecosystems, *North Carolina, Creeping Swamp(NC), Creeping Swamp watershed(NC), Organic carbon concentrations.

Organic carbon concentrations were monitored in 7 small N.C. streams, 4 of which had been channelized. Seasonal patterns of organic carbon concentrations were different between channelized streams and natural swamp-streams; however, there was overlap in weighted mean annual organic carbon concentrations. Major inputs, outputs and internal ecosystem flows of organic carbon cycling processes in Creeping Swamp were measured, and the annual organic carbon budget was made for 1977. Export of primarily dissolved organic carbon from Creeping Swamp varied seasonally. Annual exports from this and the other streams were linearly related to annual runoff. These exports were larger than upland watersheds probably as a result of increased contact time between ground litter and surface water and evapotranspiration in swamp ecosystems. It is hypothesized that organic carbon export is important to downstream secondary productivity, especially in estuaries. (DiNardi-NC)
W80-03906

MAXIMUM UTILIZATION OF WATER RESOURCES IN A PLANNED COMMUNITY: CHLORINE AND OZONE TOXICITY EVALUATION,
Rice Univ., Houston, TX. Dept. of Biology.
B. Hammond, and J. Bishop.
Available from the National Technical Information Service, Springfield, VA 22161 as PB80-131121, Price codes: A03 in paper copy, A01 in microfiche. Environmental Protection Technology Series Report No EPA-600/2-79-050e, August 1979. 47 p, 19 Fig, 3 Tab, 17 Ref. 802433.

Descriptors: *Chlorination, *Ozone, *Channel catfish, *Waste water treatment, Toxicity, Bioassay, Lethal limit, Fish physiology, Environmental effects, Fish toxins, Disinfection, Analytical techniques, Water pollution sources, Gills, Kidneys, The Woodlands.

Fingerling channel catfish, Ictalurus punctatus, were used in bioassays to study the effects on aquatic organisms of waste water disinfection by chlorine and/or ozone as part of an evaluation of the water resources plan for The Woodlands, a planned urban development. The Woodlands, located near Houston, Texas, is designed so that impoundments in the community that will be used for recreational fishing will receive reclaimed waste water. Both flow through and standard static bioassays were conducted and compared to determine an accurate LC50 for chlorine while a flow through bioassay alone was used for the ozone. Fish used in the study underwent cannulation and catheterization to facilitate monitoring of gill and kidney functions. Results show that the flow through bioassay for chlorine produced a lower 96 hour LC50 than did the static bioassay, with an LC50 of 0.07 mg/l chlorine for the flow through versus an LC50 of 0.45 mg/l chlorine for the static bioassay. From these values and considerations of the techniques used it is concluded that the final concentration of chlorine in receiving waters should not exceed 0.007 mg/l. Ozone was more toxic to fingerlings than chlorine with a 96 hour LC50 of 0.03 mg/l. From this value and the highly reactive nature of ozone it is concluded that if ozone can be detected either by analytical techniques or by its odor it exceeds safe environmental limits. Both disinfectants had little effect on kidney functions but both drastically reduced the ability of gills to absorb sodium from water. Long term exposure to ozone had little effect on blood pressure and heart rate while long-term chlorine exposure greatly reduced both. (Seigler-IPA)
W80-03921

POLYCHLORINATED BIPHENYLS: PHYTOTOXICITY, ABSORPTION AND TRANSLOCA-

TION BY PLANTS, AND INACTIVATION BY ACTIVATED CARBON,
North Carolina State Univ. at Raleigh. Dept. of Crop Science.
J. B. Weber, and E. Mrozek, Jr.
Bulletin of Environmental Contamination and Toxicology, Vol 23, p 412-417, 1979. 4 Tab, 15 Ref. OWRT-B-122-NC(1), 14-34-0001.

Descriptors: *Polychlorinated biphenyls, *Activated carbon, *Plant growth, Plant uptake, Hazardous waste, Chlorinated hydrocarbon, Toxic substance, Waste treatment, Soil absorption, Toxicity, *PBC spills, North Carolina.

A large spillage of polychlorinated biphenyls (PCBs) in North Carolina stimulated this investigation which (1) examined the effects of soil-applied PCB on soybean and fescue growth, (2) determined the amount of PCB absorbed and translocated by the 2 plant species, and (3) determined if activated carbon would inactivate PCB and prevent its uptake by plants. Results indicate that PCB applied to soil significantly inhibited height and fresh top weight of soybean plants at high application rates. Leaf malformation was also observed. Activated carbon added to the soil removed the inhibitory effects of PCB at all rates of application.
W80-03924

FEATURES OF THE STRUCTURE AND TROPHIC LINKS OF PLANKTONIC ASSOCIATIONS IN TWO LAKES WITH DIFFERNET DEGRESS OF SALINITY,
Akademiya Nauk SSSR, Moscow. Inst. of Limnology.
V. G. Drabkova, G. I. Letanskaya, and E. S. Makartseva.
The Soviet Journal of Ecology, Vol 9, No 1, p 68-73, January-February 1978. 4 Tab, 21 Ref.

Descriptors: *Plankton, *Lakes, *Salinity, *Trophic level, *Biomass, Phytoplankton, Bacterioplankton, Zooplankton, *USSR, Lake B. Shentropai(USSR), Decomposing organic matter, Lake Atkul(USSR), Ural Mountains(USSR), Saline water, Saline lakes, Ions, Sampling, Ecology, Ecosystems, Biodegradation, Degradation(Decomposition), Food webs.

Ecological production characteristics of phytoplankton, bacterioplankton and zooplankton were studied for two forest-steppe lakes in the southern Ural Mountains region of the USSR in Chelyabinsk Province, May-October, 1974. Plankton sampling comparative analysis shows that with increasing water salinity, impoverishment of species composition occurs for phytoplankton and zooplankton, zooplankton biomass rises sharply as compared with phytoplankton and bacterioplankton, and feeding interrelationships between these associations become more strained. Algae bacteria cannot satisfy zooplankton food requirements. Low phytoplankton and bacterioplankton biomass in a mineralized lake is caused by domination of small algae and bacteria forms. With increased salinity, zooplankton plays a greater role in organic matter decomposition. Lake Atkul' and Lake B. Shantropai, located 9 km apart, are characterized by shallow depths and high exposure; the lakes differ sharply in hydrochemical indices and above all in the total of basic ions. Zooplankton is much more important in the Lake B. Shentropai ecosystem (total ions up to 16 g/l) compared to Lake Atkul' (2.5 g/l). Moreover, its importance is almost doubled in the presence of decomposing organic matter; pressures of feeding interrelationships simultaneously increases zooplankton importance. Zooplankton biomass in Lake B. Shantropae exceeds phytoplankton biomass by more than 10 times and bacterioplankton biomass by more than four times. (Harris-Wisconsin)
W80-03963

STUDIES ON THE PLANT COMMUNITY OF A NORTH FLORIDA SALT MARSH PART II. NUTRITIVE VALUE AND DECOMPOSITION,
Florida Agricultural and Mechanical Univ., Tallahassee.
W. L. Kruczynski, C. B. Subrahmanyam, and S. H. Drake.
Bulletin of Marine Science, Vol 28, No 4, p 707-715, October 1978. 2 Fig, 4 Tab, 22 Ref. DOAg 416-15-15.

Descriptors: *Salt marshes, *St. Marks(FL), *Halophytes, *Spatial distribution, *Decomposing organic matter, Spartina alterniflora, Leaves, Plant physiology, Plant morphology, Biochemistry, Rhizomes, Biodegradation, Speciation, Carbohydrates, Proteins, Juncus roemerianus, Distichlis spicata, Chemical analysis, Distribution patterns, Florida.

This study summarizes zonal variations in nutritive values of live, dead and decomposing plants in tidal marshes near St. Marks, Florida September 1974-August 1975. Juncus roemerianus and Spartina alterniflora shoots and Juncus rhizomes were sampled bimonthly in each of three marsh zones: low (LM), upper (UM) and high (HM) zones. Distichlis spicata was sampled only in HM. Ash content of Juncus leaves and rhizomes decreases from LM toward HM, reflecting adaptations to soil gradients. Caloric value, lipid and protein content of live Juncus leaves are smallest in UM, indicating that nitrogen may be limiting in UM zones. Juncus rhizomes have a higher percentage of ash and carbohydrate than leaves. Spartina nutrient zonal variations are significant; leaf protein content is lowest in UM, ash content is greatest in HM. Spartina has higher ash contents than Juncus in all areas. Distichlis protein and lipid content is lower than that of either live Juncus or Spartina, while Distichlis carbohydrate is higher than both. Concentrations of Fe and B in live Juncus leaves increase from LM to HM, while concentrations of Na, Al and Mo are highest in LM leaves. Spartina concentrations of K, Al, Mo and Fe increase toward LM, while Mg increases toward HM. Concentrations of most amino acids are greatest in LM and lowest in UM plants. Juncus annual decomposition is 70% in LM and UM and 30% in HM; Spartina litterbags loose 80-89% of weight at all marsh sites. (Danovich-Wisconsin)
W80-03975

ENVIRONMENTAL ASPECTS OF OCEAN DUMPING IN THE WESTERN GULF OF MEXICO,
Texas A and M Univ., College Station.
E. Atlas, J. Brooks, J. Trefry, T. Sauer, and C. Schwab.
Journal of the Water Pollution Control Federation, Vol 52, p 329-350, 1980. 13 Fig, 10 Tab, 33 Ref.

Descriptors: *Sewage sludge, *Sewage disposal, *Gulf of Mexico, Chemical properties, Biodegradation, Microbial degradation, Bacteria, Industrial wastes, Chemical wastes, Heavy metals, Organic compounds, Productivity, Toxicity, Phytoplankton, Turbidity, Water chemistry, Waste disposal, Oceans.

Field and laboratory studies were conducted of an ocean-dumped waste containing biological sludge from a chemical biotreatment plant. During July 1977, a test dump was monitored to study the chemical behavior and dispersal of waste at a deep-water dumpsite in the western Gulf of Mexico. Nearly 100 organic compounds were detected in the waste, and some heavy metals were measured in significant amounts. At the diluted levels usually encountered in the ocean, adverse effects of such a waste on phytoplankton productivity would not be measurable with the techniques used. Increased turbidity and chemical residues could not be measured in the field past 24 hours. (Deal-EIS)
W80-03980

FUNDAMENTAL STUDIES ON THE INFLUENCE OF OIL POLLUTION UPON MARINE ORGANISMS--V THE TOXICITY OF THE GELLING COMPOUNDS FOR PETROLEUM TO MARINE ORGANISMS (IN JAPANESE),
Tokyo Univ. (Japan). Dept. of Fisheries.
For primary bibliographic entry see Field 5A.
W80-03981

HEAVY METAL TOLERANCE OF MARINE PHYTOPLANKTON. IV. COMBINED EFFECT OF ZINC AND CADMIUM ON GROWTH AND UPTAKE IN SOME MARINE DIATOMS,
Trondheim Univ. (Norway). Inst. of Marine Biochemistry.
For primary bibliographic entry see Field 5A.
W80-03982

HEAT RESISTANCE OF CELLS OF UPPER SUBLITTORAL BIVALVE MOLLUSKS OF SANDY INFAUNA IN PETER THE GREAT BAY (SEA OF JAPAN),
Akademiya Nauk SSSR, Vladivostok. Inst. Morskogo Biologii.
V. S. Vasil'eva.
The Soviet Journal of Marine Biology, Vol 4, No 1, p 523-526, 1978. 1 Fig, 1 Tab, 8 Ref.

Descriptors: *Mollusks, *Heat resistance, *Water temperature, *Bills, *Sea of Japan, Peter the Great Bay(USSR), Animal physiology, Benthic fauna, Spatial distribution, Thermal stratification, Adaptation, Toxicity, Cytological studies.

The author determines the heat resistance of eight species of bivalve mollusks of sandy infauna of the upper sublittoral of Peter the Great Bay (USSR). Specifically, the heat resistance of cells of ciliated epithelium of mollusk gills was examined. As is the case in bottom invertebrates of epifauna, the differences in heat resistance of species of infauna mollusks are in conformance with their vertical and geographical distribution and their environmental temperatures. (Deal-EIS)
W80-03983

THE BACTERIAL FLORA OF CERTAIN MARINE FISHES AND PRAWNS IN COCHIN WATERS IN RELATION TO THEIR ENVIRONS,
Central Inst. of Fisheries Technology, Cochin (India).
T. C. Karthiayani, and K. M. Iyer.
Journal of the Marine Biological Association of India, Vol 17, No 1, p 96-100, 1975. 2 Tab, 10 Ref.

Descriptors: *Marine bacteria, *Spatial distribution, *Tissue analysis, *Achromobacter, *Vibrio, *Prawns, *Sardines, *India, Pseudomonas, Bacteria, Cultures, Chemical analysis, Cytological studies, Bottom sediments, Lobsters, Seasonal, Depth, Biological communities.

Commercially important fishes like sardines, prawns, lobster and seer fish caught off Cochin, sea water samples gathered from different depths (surface, middle and bottom) and bottom mud were subjected to bacteriological analysis. Qualitatively the predominant organisms found associated with these marine animals were the gram negative, asporogenous, rod-like bacilli of the genera Pseudomonas, Achromobacter and Vibrio. Sea water and bottom mud samples also showed a predominance of gram negative rods, though with considerable variation in generic composition with depth. Quantitatively the 'bacterial density' of the sea water increased with depth, the highest aerobic count being shown by bottom mud and the least by surface water up to 14 meters depth. Compared to bottom mud, a 10 to 100 fold increase in the bacterial count was observed on the body of the fishes in general and a higher increase (10 to the third power to 10 to the fourth power fold) at the gills and the highest (10 to the fourth power to 10 to the fifth power fold in the guts of sardines have been constantly recorded. The significance of the observation has been discussed in relation to the keeping quality of the fish. (Deal-EIS)
W80-03984

EFFECT OF HEXACHLORAN ON OXYGEN CONSUMPTION OF NEOGOBIUS MELANOSTOMUS AND NEOGOBIUS FLUVIATILIS,
Odessa State Univ. (USSR). Dept. of Hydrobiology.
F. C. Zambriborshch, and B. I ai.
The Soviet Journal of Marine Biology, Vol 4, No 1, p 526-529, 1978. 4 Fig, 4 Tab, 8 Ref.

Descriptors: *Oxygen requirements, *Fish physiology, *Pesticide toxicity, *Hexachloran, *Neogobius, Respiration, Animal metabolism, Chemical analysis, Oxygen, Chlorinated hydrocarbon pesticides, Fish populations, Water pollution effects.

The effect of hexachloran on oxygen consumption of Neogobius melanostomus and N. fluviatilis is investigated. The investigation shows that this pesticide in concentrations lower than the maximum permitted (0.006-0.012 mg/liter) affects respiration and intensifies the 'group effect' in oxygen consumption. The ability to restore respiration disrupted by the pesticide was the same in these fishes. Those poisoned by hexachloran in concentrations of 0.006 and 0.012 mg/liter were unable to restore oxygen consumption to normal for a period of up to no less than three days. (Deal-EIS)
W80-03985

DDE-CONTAMINATED FISH OFF LOS ANGELES ARE SUSPECTED CAUSE IN DEATHS OF CAPTIVE MARINE BIRDS,
Southern California Coastal Water Research Project, El Segundo, CA.
D. R. Young, T. C. Heesen, G. N. Esra, and E. B. Howard.
Bulletin of Environmental Contamination and Toxicology, Vol 21, p 584-590, 1979. 3 Tab, 12 Ref.

Descriptors: *Pesticide toxicity, *DDT, *Mortality, *Cormorants, *Tissue analysis, Gulls, Pesticide residues, Chlorinated hydrocarbon pesticides, Path of pollutants, Food chains, *DDE, Polychlorinated biphenyls, Gas chromatography, California, Los Angeles Zoo.

During the spring of 1976, nearly the entire collections of Brandt's cormorants (Phalacrocorax penicillatus), guanay cormorants (P. bougainvillii), and California gulls (Larus californicus) in the Los Angeles Zoo died after exhibiting signs of pesticide poisoning. In view of the extensive DDT pollution which has occurred in the coastal waters off southern California, we conducted a limited investigation to determine if this pollutant could have been the cause of death for these specimens of marine birds. The study revealed that concentrations of DDT residues in the specimens were within the range that had been found to be lethal to American kestrels in laboratory feeding studies. The zoo birds apparently were exposed to high levels of these residues when they were fed marine fish collected near Los Angeles. (Deal-EIS)
W80-03986

HAEMATOLOGICAL ASSESSMENT OF THE EFFECTS OF THE ANAESTHETIC MS222 IN NATURAL AND NEUTRALIZED FORM IN THREE FRESHWATER FISH SPECIES: HAEMOGLOBIN ELECTROPHORESIS, ATP LEVELS AND CORPUSCULAR FRAGILITY CURVES,
Randse Afrikaanse Univ., Johannesburg (South Africa). Dept. of Zoology.
For primary bibliographic entry see Field 5A.
W80-03988

HAEMATOLOGICAL ASSESSMENT OF THE EFFECTS OF THE ANAESTHETIC MS222 IN NATURAL AND NEUTRALIZED FORM IN THREE FRESHWATER FISH SPECIES: INTRASPECIES DIFFERENCES,
Randse Afrikaanse Univ., Johannesburg (South Africa). Dept. of Zoology.
G. L. Smit, J. Hattingh, and A. P. Burger.
Journal of Fish Biology, Vol 15, p 645-653, 1979. 4 Tab, 11 Ref.

Descriptors: *Toxicity, *Fish physiology, *Organic compounds, Carp, Rainbow trout, Freshwater fish, Acids, Hydrogen ion concentration, Animal metabolism, Acid-base equilibrium, Mode of action, Chemical properties, *MS222, *Anaesthetics, *Fish anaesthetics, *Sarotherodon, *Blood chemistry, *Tissue analysis.

The effects of different concentrations of natural MS222 and neutralized MS222 were studied on the haematology of Cyprinus carpio, Sarotherodon mossambicus and Salmo gairdneri. As judged from the results, MS222, which is acidic in nature, produced haemoconcentration effects in all species studied, being least in the trout followed by carp and Sarotherodon mossambicus. These differences are ascribed to acid-base regulatory functions and metabolic activities of the fish species investigated. The use of neutralized MS222 improved the haematological profiles markedly and resulted in stabilization of acid-base parameters and red blood cells sizes and numbers. Haemoconcentration effects, however, still persisted. Trout were found to be more susceptible to the stress of MS222 anaesthesia than carp and Sarotherodon mossambicus. (Deal-EIS)
W80-03989

HAEMATOLOGICAL ASSESSMENT OF THE EFFECTS OF THE ANAESTHETIC MS222 IN NATURAL AND NEUTRALIZED FORM IN THREE FRESHWATER FISH SPECIES: INTERSPECIES DIFFERENCES,
Randse Afrikaanse Univ., Johannesburg (South Africa). Dept. of Zoology.
G. L. Smit, J. Hattingh, and A. P. Burger.
Journal of Fish Biology, Vol 15, p 633-643, 1979. 6 Tab, 18 Ref.

Descriptors: *Toxicity, *Fish physiology, *Organic compounds, Carp, Rainbow trout, Freshwater fish, Chemical properties, Mode of action, Animal metabolism, Fish management, *Sarotherodon, *MS222, *Anaesthetics, *Fish anaesthetics, *Tissue analysis, *Blood chemistry.

Interspecies haematological differences to MS222 and neutralized MS222 anaesthesia were investigated in Sarotherodon mossambicus. Cyprinus carpio and Salmo gairdneri acclimated under identical laboratory conditions. Anaesthesia with MS222 resulted in a 'chemical stress' in all fish, as was evident from changes in the haematological profiles of the animals. Such species specific variations in the haematology persisted throughout the whole experiment protocol which employed different concentrations of the anaesthetic. The use of neutralized MS222, whereby aquarium water quality remained unchanged, improved the haematological profile. Possible reasons for the interspecies differences observed are discussed. (Deal-EIS)
W80-03990

EFFECTS OF NONSETTLEABLE BIOSOLIDS ON STREAM ORGANISMS,
Academy of Natural Sciences, Philadelphia, PA.
S. L. Friant, R. Patrick, and L. A. Lyons.
Journal of the Water Pollution Control Federation, Vol 52, p 351-363, 1980. 5 Fig, 10 Tab, 11 Ref.

Descriptors: *Secondary treatment, *Sewage effluents, *Toxicity, *Aquatic life, *Streams, Suspended solids, Waste treatment, Domestic wastes, Industrial wastes, Bacteria, Chlorophyta, Protozoa, Scenedesmus, Susquehanna River, Pulp wastes, Pulp and paper industry.

Experiments were conducted to determine whether organic, nonsettleable solids that result from secondary treatment of domestic and industrial wastes are deleterious to aquatic life in a stream. These solids are very slowly settleable; in laboratory experiments at 10 mg/l they did not alter by 10% the light penetration at wavelengths of 600 and 700 nm. They did not seem to increase the bacterial count in a stream that has the characteristics of the Susquehanna River water. There was no definite stimulatory effect on the green alga, Scenedesmus abundans. Bacteria and particulates composing the nonsettleable solids were a satisfactory food source for Paramecium aurelia. (Deal-EIS)
W80-03991

THE EFFECT OF DISSOLVED COPPER ON THE INCREASE IN LENGTH OF FOUR SPECIES OF INTERTIDAL FUCOID ALGAE,
Trondheim Univ. (Norway). Museum.
For primary bibliographic entry see Field 5A.
W80-03992

EFFECT OF SALINITY OF THE WATER ON MACROPHYTES IN LAKES OF THE SOUTH URAL ZONE,
Akademiya Nauk SSSR, Leningrad. Inst. Ozerovedeniya.
I. A. Petrova.
Hydrobiological Journal, Vol 14, No 5, p 10-14, 1978. 4 Tab, 4 Ref.

Descriptors: *Salinity, *Toxicity, *Productivity, *Lakes, Water chemistry, Aquatic plants, Biomass, Biological communities, Aquatic algae, Rooted aquatic plants, USSR, Southern Urals, *Macrophytes.

The effect of water salinity on the species composition and the productivity of macrophytes in lakes is confirmed. As the salinity of lake water increases, the variety of macrophyte species decreases and freshwater forms are replaced by saltwater ones. The biomass of the most widely distributed Arundineae and Potamogeton pectinatus communities also decreases. (Deal-EIS)
W80-03993

MECHANISMS OF REGULATION OF THE ACID-BASE BALANCE IN FISH AS THEY ADAPT TO CARBON DIOXIDE LEVELS IN AN AQUEOUS ENVIRONMENT,
Akademiya Nauk URSR, Kiev. Inst. Hidrobiologii.
For primary bibliographic entry see Field 5A.
W80-03994

CHANGES IN BIOCHEMISTRY OF SOME AQUATIC ORGANISMS OF THE BARENTS SEA COAST IN EXPERIMENTAL OIL INTOXICATION,
Institute of the Biology of Southern Seas, Sevastopol (USSR).
For primary bibliographic entry see Field 5A.
W80-03996

KINETICS OF ACCUMULATION OF SOME RADIONUCLIDES BY MARINE BACTERIA,
Institute of Biology of the Southern Seas, Sevastopol (USSR).
For primary bibliographic entry see Field 5A.
W80-03997

DDT-INDUCED CHANGES IN THE ACTIVITY OF THE PHOTOSYNTHETIC SYSTEM OF AQUATIC PLANTS,
Akademiya Nauk URSR, Kiev. Inst. Hidrobiologii.
T. I. Shokod'ko, A. I. Merezhko, and M. V. Malinovskaya.
Hydrobiological Journal, Vol 14, No 5, p 75-78, 1978. 1 Fig, 2 Tab, 11 Ref.

Descriptors: *DDT, *Toxicity, *Photosynthesis, *Aquatic plants, Pesticide toxicity, Mode of action, Chlorinated hydrocarbon pesticides, Inhibition, Chlorophyll, Metabolism, Plant physiology, *Pondweed, *Potamogeton, *Hornwort, *Ceratophyllum.

A study of the effects of DDT on aquatic plants (e.g., the pondweed Potamogeton perfoliatus L. and the hornwort Ceratophyllum demersum L.) showed that even the smallest concentrations of this pesticide inhibited photosynthesis. With increasing DDT concentration, the contents of chlorophylls and carotenoids decreased (though to a lesser extent than the rate of light-induced ferricyanide reduction), as did oxygen evolution. The processes associated with C02 assimilation were inhibited. In plants with a high chlorophyll content (pondweed), the photochemical activity (PCA) per unit weight of this pigment is lower than in species with low chlorophyll content (hornwort). (Deal-EIS)
W80-03998

ACUTE TOXICITY OF SOME EXPERIMENTAL ROAD SURFACING COMPOUNDS TO DAPHNIA PULEX,
Washington State Univ., Pullman. Dept. of Civil and Environmental Engineering.
G. C. Bailey.
Bulletin of Environmental Contamination and Toxicology, Vol 21, p 618-623, 1979. 4 Tab, 4 Ref.

Descriptors: *Toxicity, *Daphnia, *Highway icing, *Deicers, Paving, Road construction, Melting, Snow removal, Bioassay, Asphalt, Salts, Chemical analysis, Mortality, Leachate, Chemical properties.

The many damages caused by the use of salt for road deicing have prompted the development of several experimental chemical compounds. These compounds are potential contaminants of surface waters through runoff from prepared road surfaces. To assess the potential environmental hazard of these compounds bioassays were performed using Daphnia pulex. The 06-H LC50 was determined for eight experimental compounds. (Deal-EIS)
W80-04003

LONG-TERM EFFECTS OF WATER-SOLUBLE FRACTIONS OF KUWAIT CRUDE OIL ON THE LARVAL AND JUVENILE DEVELOPMENT OF THE MUD CRAB EURYPANOPEUS DEPRESSUS,
Delaware Univ., Lewes. Marine Studies Complex.
For primary bibliographic entry see Field 5A.
W80-04004

SOME BIOCHEMICAL CONSTITUENTS OF STAGE I AND II NAUPLII OF BALANUS BALANOIDES (L.) AND THE EFFECT OF ANOXIA ON STAGE I,
Dunstaffnage Marine Research Lab., Oban (Scotland).
Y. Achituv, J. Blackstock, M. Barnes, and H. Barnes.
Journal of Experimental Marine Biology, and Ecology, Vol 42, p 1-12, 1980. 5 Tab, 34 Ref.

Descriptors: *Enzymes, *Metabolism, *Mollusks, *Anaerobic conditions, Dissolved oxygen, Oxygen requirements, Proteins, Lipids, Biochemistry, Aerobic conditions, Growth stages, Animal physiology, Energy conversion, *Barnacles, *Tissue analysis.

Some aspects of the energy-yielding metabolism of early larval stages of Balanus balanoides have been investigated by comparison of the concentrations of some biochemical constituents and certain enzyme activities in newly hatched stage I nauplii, stage I nauplii maintained for 4 h under anaerobic conditions, and stage II nauplii obtained after allowing stage I to remain in sea water in aerobic conditions for 24 h. The mean dry weight per nauplius was 1.02 microg for stage I and 0.78 microg for stage II under aerobic conditions and it is thought that the main contribution to this weight loss is from protein (and some lipid) metabolized in order to maintain the vigorous swimming of the non-feeding stage I nauplius. Carbohydrate and free amino-acid concentrations and the activity of malate dehydrogenase, lactate dehydrogenase, and fructose-1,6-diphosphate aldolase were similar in stage I and stage II. Protein, and to a lesser extent lipid, remain the major substrates used under anaerobic conditions but the decreases in these could not be accounted for by increases in metabolic intermediate compounds. A small increase in lactate and succinate may possibly account for the small amount of carbohydrate utilized under anaerobic conditions. The results are discussed in terms of current knowledge of the metabolism of invertebrates with particular reference to the effect of anaerobiosis. (Deal-EIS)
W80-04005

SURVIVAL OF JUVENILE SPOT (LEIOSTOMUS XANTHURUS) EXPOSED TO BROMOCHLORINATED AND CHLORINATED SEWAGE IN ESTUARINE WATERS,
Virginia Inst. of Marine Sciences, Gloucester Point.
For primary bibliographic entry see Field 5A.
W80-04008

ON THE RESISTANCE OF ISOLATED BIVALVE GILL PIECES TO OXYGEN DEFICIENCY AND HYDROGEN SULPHIDE,
Sao Paulo Univ. (Brazil). Dept. de Fisiologia Geral.
K. Hiroki.
Boletim de Fisiologia Animal, Vol 1, p 9-20, 1977. 3 Fig, 4 Tab, 19 Ref.

Descriptors: *Lethal limit, *Oxygen requirements, *Animal physiology, *Mollusks, *Tissue analysis, *Anomalocardia, *Iphigenia, *Perna, *Gills, *Brazil, Hydrogen sulfide, Toxicity, Water chemistry, Animal metabolism, Sea water, Chemical analysis, Habitats, Intertidal areas, Littoral.

The lethal limits (LT50) of isolated gill pieces of three bivalve species commonly found in the Brazilian coastal waters, both in low oxygen concentration and in simultaneous presence of hydrogen sulfide, were determined. Anomalocardia brasiliana and Iphigenia brasiliensis inhabit the intertidal zone and Perna perna the sublittoral fringe. Anomalocardia brasiliana was the most resistant species in both experimental conditions, followed by Perna perna and Iphigenia brasiliensis. The survival times were longer in oxygen deficient sea water than in the presence of hydrogen sulphide. Correlation between the LT50 values and the species habitats was observed. (Deal-EIS)
W80-04009

INDICATION OF ANTHROPOGENIC EUTROFICATION IN LAKE LADOGA,
Akademiya Nauk SSSR, Leningrad. Inst. Ozerovedeniya.
I. I. Nikolayev, and N. A. Petrova.
Hydrobiological Journal, Vol 14, No 5, p 1-6, 1978. 5 Tab, 23 Ref.

Descriptors: *Lakes, *Trophic level, *Phytoplankton, *Zooplankton, Dominant organisms, Seasonal, Mesotrophy, Eutrophication, Productivity, Crustaceans, Rotifers, Protozoa, Biological communities, Aquatic populations, Biomass, USSR, Lake Ladoga.

A comparison of data on the present planktonic community in Lake Ladoga with data from studies done at the beginning of the century and in the 1960s shows that although the species distribution in phyto- and zooplankton communities has in general remained stable, there has been a change in the dominant species and an increase in algal concentrations. During the spring diatom bloom in the southern and eastern parts of the lake, which are the most productive, the abundance and biomass of phytoplankton now exceed by 1.5 to 5 times the maximum deviations from the mean recorded in 1960 to 1962. Zooplankton (crustaceans, rotifers and protozoans) density in the top 5 m layer of water resembles that in mesotrophic lakes. Based on chlorophyll content of plankton, Lake Ladoga is now mesotrophic. (Deal-EIS)
W80-04010

ELEMENTAL CONTENT OF AQUATIC ORGANISMS INHABITING A POND CONTAMINATED WITH COAL FLY ASH,
Virginia Polytechnic Inst. and State Univ., Blacksburg. Office of Occupational Health and Safety.
For primary bibliographic entry see Field 5B.
W80-04011

EXTENT AND NATURE OF THERMAL STRESS ON COPEPOD POPULATIONS,
Maryland Univ., Baltimore County, Baltimore. Dept. of Biological Sciences.
B. P. Bradley.
Available from the National Technical Information Service, Springfield, VA 22161 as PB80-159924, Price codes: A02 in paper copy, A01 in microfiche. Water Resources Research Center, University of Maryland, College Park, Technical Report No 56, (1979). 20 p, 2 Fig, 5 Tab, 5 Ref. OWRT A-046-MD(1), 14-34-0001-8022.

Descriptors: *Copepods, *Comparative productivity, *Temperature variations, *Temperature, Adaptation, Genetic variance, Acclimation, Egg production, Eurytemora affinis.

Among populations of the copepod Eurytemora affinis grown in three constant (10, 15, 23C) and three variable environments, more genetic adaptation occurred in a temperature regime cycling at 1 degree per day than in a regime cycling at 1 degree per week or in a very gradually increasing regime. Egg production (measured in five regimes) was lowest at 23C, highest at 10 and 15C and intermediate in the two cycling regimes. Potential for further genetic and physiological adaptation remained in all regimes suggesting that lowered reproduction at higher temperatures may retard extreme selection for temperature tolerance.
W80-04014

IMMUNE RESPONSE TO BACTERIAL IMMUNIZATION OF CHANNEL CATFISH MAINTAINED IN A RECIRCULATING WATER-REUSE SYSTEM,
Memphis State Univ., TN.
D. D. Ourth.
Available from the National Technical Information Service, Springfield, VA 22161 as PB80-160393, Price codes: A03 in paper copy, A01 in microfiche. Tennessee Water Resources Research Center, University of Tennessee, Knoxville, Research Report No 73, December 1979. 22 p, 5 Fig, 2 Tab, 22 Ref. OWRT A-056-TENN(1), 14-34-0001-9045.

Descriptors: *Channel catfish, *Commercial fish, Fish farming, Agriculture, Recirculated water, Water reuse, *Aquatic bacteria, *Bacterial immunization, Analytical techniques.

Intraperitoneal immunization of channel catfish, Ictalurus punctatus, with the Gram-negative bacterium Salmonella paratyphi in Freund's complete adjuvant produced persistant serum agglutinating antibody titers of hundreds of thousands during an immune response of about one year. Bactericidal activity of two high-titered sera averaged 30% and 20%. Post-immunization bactericidal activity varied little and remained within 10% of pre-immunization activity. The enzyme lysozyme, active against Gram-positive bacteria, was present at 1.8 ug/ml serum or 34 ng lysozyme/mg protein. Channel catfish serum can therefore provide protection against both Gram-positive and Gram-negative bacteria that the catfish may come in contact with in its aquatic environment. Channel catfish (Ictalurus punctatus) skin mucus also demonstrated an immunological function. Agglutinating antibody (titer of 1:80) and a bactericidal response to Salmonella paratyphi were found in the mucus after intraperitoneal injection of bacteria. By immunodiffusion in gel, the catfish skin mucus gave a precipitin line of identity with catfish 14S serum macroglobulin against rabbit anticatfish 14S serum indicating the presence of secretory IgM in the mucus. Parenteral immunization (intraperitoneally) can thus yield specific IgM antibody in the mucus. Lysozyme at a concentration of 183 ng/ml was demonstrated in the mucus. 8% of skin mucus cells from Wrigh-stained smears were lymphocytes which are immunocompetent cells in fish.
W80-04016

NUTRIENTS LIMITING PHYTOPLANKTON PRODUCTION IN ICE-COVERED LAKE ST. CLAIR,
Windsor Univ. (Ontario). Dept. of Biology.
D. G. Wallen.
Journal of Great Lakes Research, Vol 5, No 2, p 91-98, 1979. 4 Fig, 2 Tab, 38 Ref.

Descriptors: *Nutrients, *Phytoplankton, *Limiting factors, *Lakes, Sampling, Laboratory tests, Silica, Phosphates, Phosphorus, Nitrogen, Trace elements, Water pollution, Biomass, Ice cover, Winter, Limnology, Biology, Water pollution effects, *Lake St. Clair.

Nutrient enrichment experiments on ice-bound phytoplankton populations at three stations in Lake St. Clair, of the St. Lawrence Great Lakes system, showed that silica was the primary nutrient limiting phytoplankton growth and photosynthesis in the Thames River plume in mid winter. The addition of silica at concentrations of 150 micrograms/liter or greater relieved this limitation. Phosphate appeared to be a secondary limiting factor. Stations 1 and 2 below river outlets, draining rural and urban areas, showed variable results.

Trace metal limitation was observed at station 1 on February 20, trace metal and vitamin limitation at station 2 in March. Possible limitation by phosphate was occasionally evidenced. (Sims-ISWS)
W80-04051

SHELF-SEDIMENT DYNAMICS AND SOLID-WASTE DISPOSAL,
University of Southern California, Los Angeles. Dept. of Geological Sciences.
D. S. Gorsline.
In: 'Ocean Dumping and Marine Pollution--Geological Aspects of Waste Disposal,' p 9-16, 1979. 30 Ref. Palmer, H.D. and Gross, M.G. (Eds), Dowden, Hutchinson and Ross, Inc, Stroudsburg, Pa.

Descriptors: *Dredging, *Waste disposal, *Water pollution effects, Continental shelf, Solid wastes, Sediments, Clays, Dispersion, *Outer Continental Shelf, *Ocean dumping, Dredge materials, Dump sites.

Dredged material is commonly natural material that has been deposited under riverine, estuarine or deltaic conditions. It includes natural terrigenous and biogenic detritus, organic matter and debris and adsorbed metal ions and organic compounds of natural or man-generated origins. Its dispersion is identical to dispersion for naturally contributed sedimentary materials and the particles will follow the same paths. Other than the effect of overwhelming mass dumped in a locality, the major problem environmentally is the smaller fraction of dredge spoil that contains pollutants. Since a large proportion of these contaminants is adsorbed on the clay fraction which moves as suspended load, the major environmental impact is the disposal of the fine fraction. Most harbors are located in estuaries or the lower reaches of major rivers, and so the most complex problems of control of spoil disposal are due to the inherent characteristics of estuarine circulation and particularly to the fact that estuaries are sediment traps. They typically draw from both river input and from adjacent shelves and thus the problem of finding suitable dump sites outside a given system may be economically and technically difficult. More information is needed about such problems as the rates of benthic boundary layer processes, the paths of suspended sediment transport over shelves and the net contributions of estuaries to shelves in normal and storm periods. Deep water sites should be avoided until more is known about the biology of those environments. (Sinha-OEIS)
W80-04063

WASTE DISPOSAL AND DREDGING ACTIVITIES: THE GEOLOGICAL PERSPECTIVE,
Johns Hopkins Univ., Baltimore, MD. Chesapeake Bay Inst.
M. G. Gross, and H. D. Palmer.
In: 'Ocean Dumping and Marine Pollution--Geological Aspects of Waste Disposal,' p 1-7, 1979. 36 Ref. Palmer, H.D. and Gross, M.G. (Eds), Dowden, Hutchinson and Ross, Inc, Stroudsburg, Pa.

Descriptors: *Dredging, *Waste disposal, *Water pollution effects, Sediments, Benthos, Environmental effects, Resources development, *Outer Continental Shelf, Ocean dumping, Dredged material, Geological effects.

Dredging and disposal of dredged materials are among the most important activities affecting estuaries and the coastal ocean in the United States. Effects of dredged material disposal on continental shelves can be appreciated only when it is realized that, except for a few major rivers, nearly all sediment transported by rivers is trapped and normally deposited in estuaries, bays, and harbors. Consequently, dredging operations are not only supplying a large quantity of waste solids but are moving them to the continental shelf where little other sediment is being deposited to dilute or bury the wastes. In areas where large volumes of materials have been dumped for an extended period, bottom-dwelling communities have been transformed substantially. The abundance of number of different types of marine organisms was substantially reduced in the waste disposal areas of the New York Bight. The presence of human pathogens in the sewage-drived constituents in many dredged materials makes ocean bottoms used for waste disposal unsuitable for production of shellfish for human consumption and less attractive for recreational fishing. Disposal of waste solids in continental shelf areas can alter bottom topography and sediment composition and texture. Therefore it is clear that dredging and disposal operations cannot be ignored and it is essential that the multiple interactions between natural agents and processes and the by-products of 'civilization' be understood. (Sinha-OEIS)
W80-04064

STABILITY OF DREDGED MATERIAL DEPOSITED SEAWARD OF THE COLUMBIA RIVER MOUTH,
Washington Univ., Seattle. Dept. of Oceanography.
R. W. Sternberg, J. S. Creager, J. Johnson, and W. Glassley.
In: 'Ocean Dumping and Marine Pollution--Geological Aspects of Waste Disposal,' p 17-49, 1979. 13 Fig, 8 Tab, 23 Ref. Palmer, H.D. and Gross, M.G. (Eds), Dowden, Hutchinson and Ross, Inc, Stroudsburg, Pa.

Descriptors: *Waste disposal, *Solid wastes, *Water pollution effects, *Sediments, Sediment transport, Oregon, Washington, Environmental effects, *Outer Continental Shelf, Columbia River, Dredged material, Ocean dumping.

A two-part study was conducted in a region seaward of the Columbia River where disposal of large quantities of dredged material has occurred over the last several decades. The first part included repeated bathymetric surveys and sampling for distribution and seasonal variations of sediment texture and mineral composition throughout the study area, and especially at designated disposal sites. Near-bottom hydraulic conditions (waves, tides, currents, turbidity) were also measured at several sites and during all seasons. The second part was related to an experiment in which 459,000 cubic meters of material dredged from the Columbia River estuary were discharged at a designated site, which was monitored before, during, and after disposal. Sedimentological aspects of the study were to identify and map all deposits of dredged material and to recognize seasonal and long-term changes. The objectives of the hydraulic aspects were to document ambient near-bottom conditions, and their effect on the deposit at the experimental site. Deposits of dredge material can be identified relative to the surrounding sediments, because they tend to maintain their identity for many years. Sedimentological evidence suggests that the deposits disperse northward at approximately 0.5 km per year. At the experimental disposal site the volume of the bottom deposit was 61% of the total material dumped. Calculations of bedload transport rates, based on seasonal measurements of bottom currents, suggest that 635 cubic meters of material (0.2% of the total deposit) spread northward from the site at about 0.4 km per year. This is similar to the rates determined by analysis of sediment mineralogy. (Sinha-OEIS)
W80-04065

GEOLOGIC EFFECTS OF OCEAN DUMPING ON THE NEW YORK BIGHT INNER SHELF,
Corps of Engineers, Fort Belvoir, VA.
S. J. Williams.
In: 'Ocean Dumping and Marine Pollution--Geological Aspects of Waste Disposal,' p 51-72, 1979. 10 Fig, 2 Tab, 17 Ref. Palmer, H.D. and Gross, M.G. (Eds), Dowden, Hutchinson and Ross, Inc, Stroudsburg, Pa.

Descriptors: *Waste disposal, *Water pollution effects, *Solid wastes, Sediment transport, Geology, Sewage disposal, Dispersion, Environmental effects, New York, Sludge, *Outer Continental Shelf, New York Bight, Ocean dumping.

High resolution seismic reflection records, sediment cores and deep borings, and comparison of bathymetric charts from 1845 to 1973 provide evidence that ocean dumping of assorted solid materials has significantly filled parts of the Hudson shelf channel, and is an important geologic process. Ocean disposal of natural and man-made wastes was official initiated seaward of New York Harbor in 1888 to relieve health problems, congestion and accelerated shoaling of navigation channels long associated with uncontrolled disposal within the city and adjacent waterways. Records show that about 850 million cubic meters of liquid and solid wastes have been dumped in the past 85 years. This has resulted in creation of several mounds with relief of about 15 m covering an area of about 9 thousand hectares. The calculated volume of anthropogenic solids filling the Hudson channel is 318 million cubic meters. Much of the material is similar in character to indigenous sediment. The results indicate most materials except sewage sludge are fairly stable and remain in the original dump sites. In spite of large volumes of sludge dumped at the same site since 1924, no evidence of significant accumulation on the seafloor has been found. (Sinha-OEIS)
W80-04066

MUD DEPOSITS NEAR THE NEW YORK BIGHT DUMPSITES: ORIGIN AND BEHAVIOR,
National Oceanic and Atmospheric Administration, Miami, FL. Atlantic Oceanographic and Meteorological Labs.
G. L. Freeland, D. J. P. Swift, and R. A. Young.
In: 'Ocean Dumping and Marine Pollution--Geological Aspects of Waste Disposal,' p 73-95, 1979. 13 Fig, 1 Tab, 40 Ref, Palmer, H.D. and Gross, M.G. (Eds), Dowden, Hutchinson and Ross, Inc, Stroudsburg, Pa.

Descriptors: *Waste disposal, *Water pollution effects, *Sediments, *Sediment transport, Sewage disposal, Environmental effects, New York, Mud, *Outer Continental Shelf, New York Bight, Ocean dumping, Dredged material, Dumpsites, Sewage sludge.

A detailed investigation of the floor of the New York Bight apex reveals that muddy sediment occurs in the Christiaensen Basin, in the fringing lagoons and marshes near the mouths of tidal inlets, and in ephemeral patches on the Long Island shoreface, where mud settles into the troughs of sandwave-like bedforms. The appearance and disappearance of these nearshore mud patches has led to an erroneous concept of a sewage-sludge 'front' advancing toward the Long Island beaches from the sewage-sludge dumpsite. While Bight apex mud deposits do contain sewage sludge, this contamination is usually not apparent in gross physical properties or composition; sophisticated chemical techniques are required to detect the contamination. Fine-grained deposits near the New York Bight sewage-sludge dumpsite are primarily of natural origin and should, therefore, be called mud, not sludge. Fine-grained sediment at the dredge-spoil dumpsite is also mostly natural sediment, but it is anthropogenic in that it is dredged harbor and estuary sediment. The impact of sewage-sludge dumping in the New York Bight apex depends to a large extent on the pathways and rates of natural sediment transport system. Such limited information as is available suggests that the rate of sewage-sludge dispersal is high relative to the rate of input. The model leads to the inference that sewage sludge is rapidly diluted in the Bight apex by natural sediment, and the more stable sewage-sludge components are widely dispersed through the natural mud deposits of the New York Bight system. (Sinha-OEIS)
W80-04068

CONTAINMENT OF PARTICULATE WASTES AT OPEN-WATER DISPOSAL SITES,
Yale Univ., New Haven, CT. Dept. of Geology and Geophysics.
H. J. Bokuniewicz, and R. B. Gordon.
In: 'Ocean Dumping and Marine Pollution--Geological Aspects of Waste Disposal, p 109-129, 1979. 10 Fig, 20 Ref, Palmer, H.D. and Gross, M.G. (Eds), Dowden, Hutchinson and Ross, Inc, Stroudsburg, Pa.

Descriptors: *Waste disposal, *Sediments, *Water pollution effects, Sedimentation, Environmental effects, New York, *Outer Continental Shelf, Dredged material, Ocean dumping, New York Bight, Sedimentary regimes, Biological effects.

The degree of retention of particulate silt-clay size waste at open-water disposal sites depends primarily on the sedimentary regime at the site and the height of the waste deposit. In marine localities the tidal stream will disperse waste placed in a deposit rising above natural topographic features of the bottom unless its surface is armored by erosion-resistant material or the natural sedimentation rate exceeds a critical value that depends on pile height. These factors are evaluated for dredged material disposal sites in Long Island Sound. Silt-clay is found to be dispersed at the Cornfield Point site, where the natural sedimentation rate is zero, but retained at the New Haven site, where natural sedimentation is 0.8 kgm/sq m yr). At the latter site 1.2 x 1,000,000 cu m of dredged material was placed in a conical mound 8 m high. Self-consolidation occurred over several weeks and caused an outward advection velocity of interstitial water as great as 0.00005 cm/sec. The top of the waste pile penetrates the wave-affected zone but, because it is armored with sand and clods of cohesive silt, it is not dispersed. The lower part of the waste pile is unarmored. Tidal resuspension of the neighboring muddy bottom and the waste deposit occurs every tidal cycle and is increased by as much as a factor of ten during severe storms. A layer of wastes less than 1 cm thick is intermixed with sediments from the neighboring sea floor within a few weeks after deposition is completed; subsequent entrance of wastes into the water column is due to biological mixing in the top 10 cm of the waste deposit. The results show that permanent waste deposits may be constructed in coastal localities with favorable natural sedimentary regimes provided close control over the deposition process is attained. (Sinha-OEIS)
W80-04069

DREDGING AND DISPOSAL IN CHESAPEAKE BAY, 1975-2025,
Johns Hopkins Univ., Baltimore, MD. Chesapeake Bay Inst.
M. G. Gross, and W. B. Cronin.
In: 'Ocean Dumping and Marine Pollution--Geological Aspects of Waste Disposal,' p 131-145, 1979. 3 Fig, 7 Tab, 26 Ref, Palmer, H.D. and Gross, M.G. (Eds), Dowden, Hutchinson and Ross, Inc, Stroudsburg, Pa.

Descriptors: *Waste disposal, *Dredging, *Water pollution effects, Sediment transport, Environmental effects, Resources development, *Outer Continental Shelf, Chesapeake Bay, Ocean dumping, Dredged material, Biological effects.

In Chesapeake Bay frequent dredging is required in three locations: Bay entrance, harbors, and the turbidity maxima at the fresh-/salt-water interfaces. Between 1975 and 2025, 560 x 1,000,000 cu m are scheduled to be dredged to maintain existing channels and to deepen them to accommodate larger vessels. One third of the dredging is associated with new construction projects; two thirds comes from maintenance dredging. Approximately half the maintenance dredging will be done in port areas where much of the dredged material may be mixed with industrial wastes and sewage discharged. Sources of deposits in channels and port facilities in Chesapeake Bay are poorly understood. Although river sediment discharge to Chesapeake Bay is the main source, smaller but unknown amounts of sediment are contributed by sewage treatment plants, urban runoff, industrial processes, and shoreline erosion. Available data suggest mostly localized and transitory biological effects for those disposal operations involving unpolluted materials that do not alter the physical or chemical character of the bottom. Long-term effects of dredged material disposal in the Bay such as altered current regimes or sediment transport can not be predicted with confidence. Because of shortages of wetland disposal sites, opposition to open-water disposal, and high costs of diked disposal areas, new disposal sites and techniques will likely be needed in the next 50 years to handle the disposal of materials from needed dredging in Chesapeake Bay. Dredging and disposal of dredged materials will continue to be major geological processes in Chesapeake Bay. (Sinha-OEIS)
W80-04070

THE PROBLEM OF MISPLACED SEDIMENT,
Virginia Inst. of Marine Sciences, Gloucester Point.
M. M. Nichols.
In: 'Ocean Dumping and Marine Pollution--Geological Aspects of Waste Disposal,' p 147-161, 1979. 9 Fig, 19 Ref, Palmer, H.D. and Gross, M.G. (Eds), Dowden, Hutchinson and Ross, Inc, Stroudsburg, Pa.

Descriptors: *Dredging, *Water pollution effects, *Estuaries, Environmental effects, Sediment transport, Resources development, *Outer Continental Shelf, Ocean dumping, Dredged material, Dredge disposal.

Disposal of estuarine dredged material is a major depositional process with important sedimentologic and hydraulic consequences. Large-scale dredging in U.S. East Coast estuaries has cut channels far below natural equilibrium depths and induced rapid sediment accumulation. In turn, the increased frequency of dredging has created a massive disposal problem and a need for ocean dumping. An estuary channel attains maximum stability by adjusting its bed geometry and hydraulic regime. When a channel is deepened, tidal currents are reduced and sediment deposition accelerates. Deepening causes more salty water to penetrate landward and shifts the zone of maximum shoaling upstream. Landward density currents accelerate the potential for return of dredged material from seaward reaches, while higher stratification enhances the potential for entrapment. Therefore, dredging is partly self-perpetuating. Long-continued open water disposal along channel shoulders of the Upper James Estuary, Virginia, has built up mounds close to the surface where they are subject to wave erosion and current scour. Mounds of misplaced sediment with slopes greater than 6 degrees allow return of sediment to the channel and they restrict tidal flow. By reducing the cross sectional area, they surpress the tide range and tidal discharge in landward reaches. Consequently, dispersion of pollutants is reduced and accumulation of fine-grained sediment is promoted. As a consequence of dredging and disposal, many estuaries are loosing their capacity to absorb more misplaced sediment. (Sinha-OEIS)
W80-04071

NO WASTE DISPOSAL SITES ON THE CONTINENTAL SHELF OFF THE MIDDLE ATLANTIC STATES: OBSERVATIONS MADE FROM SUBMERSIBLES,
Geological Survey, Woods Hole, MA.
D. W. Folger, H. D. Palmer, and R. A. Slater.
In: 'Ocean Dumping and Marine Pollution--Geological Aspects of Waste Disposal,' p 163-184, 1979. 8 Fig, 5 Tab, 26 Ref. Palmer, H.D. and Gross, M.G. (Eds), Dowden, Hutchinson and Ross, Inc, Stroudsburg, Pa.

Descriptors: *Waste disposal, *Water pollution effects, *Sediments, Sewage sludge, Benthos, Environmental effects, Resources development, *Outer Continental Shelf, Mid-Atlantic Bight, Ocean dumping, Acid wastes.

Nineteen dives were conducted in August 1974 and July 1975 to survey the Philadelphia sewage and DuPont acid dumpsites about 65 km southeast of the mouth of the Delaware Bay. Though 1974 dives in the sewage dumpsite were carried out the day after 2 million gallons of sewage was released, little evidence of sewage remained in the water column or on the bottom within the area of the dumpsite. Oscillatory wave motion, tidal currents, and benthic organisms apparently were the main mechanisms redistributing sediment on the bottom during the period of the dives. In 1974, at the center of the acid waste site, where a 1-million-gallon release of acid had just taken place, visibility in the water column 6-9 m deep was reduced to zero. Below this opaque layer, suspended matter was composed mainly of large reddish-yellow flocks 1-3 cm long. The visibility reduction and the flocks were apparently due to precipitates from the acid waste that were concentrated at the top of the thermocline. During dives conducted in 1974, bottom samples were collected by both the mother ship and the submersible. At five sites, in both dumpsites, gravel (including shell fragments) averaged 6.1%; sand 88%; and silt plus clay, 2.1% of the sediment. Both coarsest and finest materials were accumulating in ripple troughs. Fe, Ti, and Cr in sediments were all higher at the acid site than in surrounding areas. Thus, sewage sludge apparently was being oxidized, eaten, or transported away from the dumpsite and accumulating elsewhere, whereas some acid waste was accumulating on the bottom in the disposal area. (Sinha-OEIS)
W80-04072

MATHEMATICAL MODELING PREDICTIONS OF THE GEOLOGICAL EFFECTS OF SEWAGE SLUDGE DUMPING ON THE CONTINENTAL SHELF,
Raytheon Co., Portsmouth, RI. Environmental Research Lab.
D. O. Cook.
In: 'Ocean Dumping and Marine Pollution--Geological Aspects of Waste Disposal,' p 185-203, 1979. 11 Fig, 16 Ref. Palmer, H.D. and Gross, M.G. (Eds), Dowden, Hutchinson and Ross, Inc, Stroudsburg, Pa.

Descriptors: *Sewage sludge, *Water pollution effects, *Mathematical models, Benthos, Environmental effects, Resources development, Waste disposal, *Outer Continental Shelf, Ocean dumping, Geological effects, Mid-Atlantic Bight.

A far-field (beyond the initial mixing zone) water quality math model has been adapted to predict geological implications of ocean dumping. The example simulated is ongoing discharge of digested sewage sludge by the City of Philadelphia at a disposal site located at mid-shelf in the Middle Atlantic Bight. After calibration of the model using hydrographic field data, predictions were made of the horizontal distributions of suspended solids and deposition following an individual dumping incident. The distributions shift south-southwest of the discharge line in response to non-tidal currents and disperse over a larger area with time. The predictions are highly dependent upon assumed settling characteristics of the sludge. The hydrodynamic simulation of the study area appears to be reasonably accurate. The geological predictions, in particular those for deposition, represent a first order estimate because of uncertainties in sludge solid settling behavior and pre/post depositional sludge fate. Regarding this fate, the effects of sludge recycling by zooplankton in the water column and detritus feeders on the sea floor are unknown. Also, the presence of physical structures in bottom photographs suggests that settled sludge solids would be subject to periodic resuspension. Until these uncertainties are resolved and quantified, the primary use of predicted depositional patterns is to indicate those areas of the sea floor where the benthic community may potentially be affected by sludge disposal. (Sinha-OEIS)
W80-04073

DISTRIBUTION OF SUSPENDED PARTICULATE MATTER NEAR SEWAGE OUTFALLS IN SANTA MONICA BAY, CALIFORNIA,
University of Southern California, Los Angeles. Dept. of Geological Sciences.
R. L. Kolpack.
In: 'Ocean Dumping and Marine Pollution--Geological Aspects of Waste Disposal,' p 205-239, 1979. 25 Fig, 37 Ref. Palmer, H.D. and Gross, M.G. (Eds), Dowden, Hutchinson and Ross, Inc, Stroudsburg, Pa.

Descriptors: *Waste disposal, *Sewage sludge, *Sediment transport, Suspended solids, Sediment-water interfaces, Outfall sewers, Water pollution effects, Environmental effects, California, Resources development, *Outer Continental Shelf, Ocean dumping, Santa Monica Bay.

Distribution and transport paths of sewage particles within the water column on the Santa Monica

Shelf were studied with more than 500 light-transmission profiles made on 8 cruises between September 1970 and November 1972. Additional measurements of temperature, salinity and bottom currents were used to interpret the distribution of suspended matter in the water column. No significant accumulation of particulate material around the discharge sites has been detected. The sewage plume in Santa Monica Bay rises rapidly from an initial discharge depth of about 60 meters to about 20 meters below the water surface. On occasion the sewage effluent can be detected at the water surface. Wave action in the water column tends to disperse the sewage plume over a large part of the Santa Monica Shelf. The dominant direction of initial transport during most of the year is toward the shoreline southeast of the discharge site. Subsequently, at several reasonably consistent locations within the bay the net transport of the sewage material, as well as material derived from nearshore mixing, is directed toward the west and transported offshore in well-defined zones which are approximately normal to the coastline. The amount of suspended material transported to the offshore area via Santa Monica and Redondo canyons appears to be rather negligible during normal conditions. On the other hand, a significant portion of the suspended material in Santa Monica Bay is transported within the near-surface water column toward the offshore basins. This pattern of particle transport also takes place at the water surface and at the sediment-water interface, although there is somewhat more variation near these surfaces. (Sinha-OEIS)
W80-04074

DREDGED MATERIAL, OCEAN DISPOSAL, AND THE REGULATORY MAZE,
Smith (David D.) and Associates, San Diego, CA.
D. D. Smith.
In: 'Ocean Dumping and Marine Pollution--Geological Aspects of Waste Disposal,' p 241-262, 1979. 2 Fig, 1 Tab, 29 Ref. Palmer, H.D. and Gross, M.G. (Eds), Dowden, Hutchinson and Ross, Inc, Stroudsburg, Pa.

Descriptors: *Waste disposal, *Dredging, *Regulations, Water pollution, Environmental effects, Resources development, *Outer Continental Shelf, *Ocean dumping, Dredged material, Environmental impact statements.

Dredged material disposed of at sea each year totals about 50 to 75 x 1,000,000 cu m, which is roughly 15 to 20% of the total sediment dredged in the U.S. annually. These volumes are discharged at some 125 designated ocean disposal sites, of which about 60% are located within the three mile limit. Disposal of dredged material requires a permit issued by the Corps of Engineers in accordance with Environmental Protection Agency regulations and criteria. Obtaining this permit requires maneuvering through a complex procedural network (i.e. the regulatory maze) comprised in part by the numerous and varied criteria that govern the review and processing of the permit application. The regulations governing ocean disposal also presecribe additional sets of criteria for evaluating (1) the dredged material to be disposed of, (2) the site proposed for disposal use, and (3) the environmental effects of the proposed disposal activity. Thus, literally dozens of criteria must be considered by the Corps in reaching a decision as to whether or not a permit for ocean disposal should be issued. Unfortunately, the governing regulations contain no recommended framework or standard methodology within which these many croteria can be applied--a major omission that requires resolution. Until such a framework or methodology is established, the decisions reached using the criteria must be recognized as highly subjective and potentially vulnerable to litigation. (Sinha-OEIS)
W80-04075

EASTERN GULF OF MEXICO MARINE HABITAT STUDY. VOLUME I.
Woodward-Clyde Consultants, Orange, CA.
For primary bibliographic entry see Field 5B.
W80-04076

EASTERN GULF OF MEXICO MARINE HABITAT STUDY. VOLUME II: MAPS AND CROSS SECTIONS.
Woodward-Clyde Consultants, Orange, CA.
For primary bibliographic entry see Field 5B.
W80-04077

INVESTIGATIONS OF PHYSICAL PROCESS,
National Oceanic and Atmospheric Administration, Seattle, WA. Pacific Marine Environmental Lab.
J. A. Galt.
In: 'The AMOCO CADIZ Oil Spill. A Preliminary Scientific Report,' p 7-20, April 1978. 3 Fig, 11 Ref, 11 Photos, NOAA/EPA Special Report.

Descriptors: *Oil spills, *Oil pollution, *Water pollution effects, *Tidal effects, *Winds, Coasts, Environmental effects, Beaches, Intertidal areas, Currents(Water), Shores, *Outer Continental Shelf, Amoco Cadiz, Nearshore processes, Environmental impact, France.

The Amoco Cadiz disaster presented a unique opportunity to study oil spills in the marine environment. The massive amounts of oil discharged, and its position close to a lee shore made this a particularly interesting spill to study. The spilled oil appeared in a variety of forms. These could be described in terms of four classes: mousse, sheen, light foam, and weathered mousse as small globs. Estimates were made of what was thought to be the dominant oceanographic or metorological processes affecting the movement and spreading of the oil. Winds were strong during much of the spill event and contributed to the oil movement both directly and indirectly. Direct wind forcing was through wind/wave/oil interactions, and indirect forcing was hypothesized to take place through a sea surface set-up along the coast and subsequent development of an alongshore current system. Both components of the wind forcing tended to move the oil eastward in a coastal band during the March periods of study. Tidal forcing was investigated and estimated to play an important role through convergences and divergences in the offshore area and through the beaching/tidal pumping sequence that took place along the coast. The orientation of the coastline and alongshore current system were seen to affect the oil distribution. The stranding of heavy oil concentrations appeared to occur only during ebbing tides and seemed condition on the intertidal beach face coming in direct contact with the oil. (Sinha-OEIS)
W80-04078

CHEMICAL COMPOSITION OF SELECTED ENVIRONMENTAL AND PETROLEUM SAMPLES FROM THE AMOCO CADIZ OIL SPILL,
National Oceanic and Atmospheric, Boulder, CO. Outer Continental Shelf Environmental Assessment Program.
J. A. Calder, J. Lake, and J. Laseter.
In: 'The AMOCO CADIZ Oil Spill. A Preliminary Scientific Report,' p 21-83, April 1978. 35 Fig, 10 Tab, 4 Photos, NOAA/EPA Special Report.

Descriptors: *Oil spills, *Water pollution, *Chemical analysis, Sampling, Environmental effects, Weathering, Biota, Resources development, *Outer Continental Shelf, France, Brittany.

The analyses described in this report represent initial chemical investigations by the University of New Orleans' Center for Bio-Organic Studies (UNO-CBS), the U.S. Environmental Protection Agency, Environmental Research Laboratory, Narragansett (EPA-ERLN), and the National Oceanic and Atmospheric Administration's National Analytical Facility NOAA-NAF), on the composition and fate of oil spilled along the Brittany coastline by the Amoco Cadiz. While many of the analyses are qualitative in nature, much quantitative information is presented. The information reported is useful in studying the nature and composition of the initial petroleum entering the environment and the transformation of this material as part of the weathering process. Selected samples were collected at different locations along the Brittany coastline. Samples included weathered oil samples floating on the water surface, samples of the mousse (water-in-oil emulsion) and oily froth, soils, sediments, water column samples, and biota samples such as sea grass, polychaetes, and periwinkles from the tidal zone. Medium Arabian crude oil was analyzed as a standard. (Sinha-OEIS)
W80-04079

INVESTIGATIONS OF BEACH PROCESSES,
South Carolina Univ. Columbia. Dept. of Geology.
E. R. Gundlach, and M. O. Hayes.
In: 'The AMOCO CADIZ Oil Spill. A Preliminary Scientific Report,' p 84-196, April 1978. 65 Fig, 24 Tab, 13 Ref, 21 Photos, NOAA/EPA Special Report.

Descriptors: *Oil spills, *Water pollution effects, *Geomorphology, *Sediments, Environmental effects, Coasts, Beaches, Cleaning, *Outer Continental Shelf, Beach processes, Interstitial water.

According to the best estimate, 64,000 tons of the Amoco Cadiz oil came ashore along 72 km of the shoreline of Brittany during the first few weeks of the spill. At the end of April, the total volume of oil onshore was reduced to 10,000 tons, but, by that time, 320 km of shoreline had been contaminated. Coastal processes and geomorphology played a major role in the dispersal and accumulation of the oil once it came onshore. Although the surfaces of the beaches and tidal flats at many places were free of oil, the interstitial ground water was contaminated. This may have been the cause of the extensive biological kills at certain areas. Unfortunately, the use of large pits and trenches as collection sites for the oil may increase the amount of ground water contamination. The use of bulldozers to plow heavily oiled gravel into the surf zone for cleansing by wave action is a sound practice, from a geological point of view because no sediment is removed from the beach. Removal of sediment from certain areas increased the rate of beach erosion. The unrestricted use of heavy machinery on the beach and low-tide terrace generally turned oil deeper into the sediments. Where possible, traffic should be limited to specified access routes. (Sinha-OEIS)
W80-04080

BIOLOGICAL OBSERVATIONS,
National Marine Fisheries Service, Beaufort, NC. Southeast Fisheries Center.
F. A. Cross, W. P. Davis, D. E. Hoss, and D. A. Wolfe.
In: 'The AMOCO CADIZ Oil Spill. A Preliminary Scientific Report,' p 197-228, April 1978. 3 Fig, 2 Tab, 25 Ref, 24 Photos, NOAA/EPA Special Report.

Descriptors: *Oil spills, *Water pollution effects, *Environmental effects, *Oil pollution, Intertidal areas, Biota, Algae, Aquatic life, Resources development, *Outer Continental Shelf, *Biological effects, Brittany, Sea grasses, Patella vulgata, Patella, Aspera, Crastoderma-Cardium edule, Arenicola marina, Venerupis aurea, Littorina.

The portion of the Brittany coast impacted by the oil spill consists of diverse ecological habitats and biological communities, including exposed sandy beaches, rocky headlands, protectec bays, estuaries, and marshes. Biological communities in all these habitats were subjected to stress by the oil. Impact of the oil on intertidal communities in general was quite severe. Macroalgae on exposed rocks tended to retain the oil long after it had been removed from bare rocks by wave action. In addition to potential adverse effects of the oil on the macroalgae, retention of oil by this material undoubtedly increased contact time between the oil and organisms living beneath the algae. More chronic effects may be occurring, however, as several preliminary bioassays on these plants indicate that the fertilization process filed to occur in exposed algae. Adverse effects from exposure to oil were noted on limpets (Patella vulgata and P. aspera) over most of the impacted coastline. Nearly complete mortality of limpets and periwinkles occurred in the rocky intertidal zone immediately inshore of the wreck. Live cockles (Cerastoderma-Cardium edule), in particular, were ob-

served on the surface in sandy environments all along the affected coast. The valves of many of these animals could be pulled apart easily, which indicated their weakened condition prior to death. The mortality of intertidal organisms, in general, did not occur as soon as mousse entered their environment but was observed over a period of two months following the wreck. (Sinha-OEIS)
W80-04081

OIL SPILL CLEANUP ACTIVITIES,
Texas A and M Univ., College Station.
R. W. Hann, Jr., L. Rice, M-C. Trujillo, and H. N. Young, Jr.
In: 'The AMOCO CADIZ Oil Spill. A Preliminary Scientific Report,' p 229-275, April 1978. 26 Fig, 3 Tab, 16 Photos. NOAA/EPA Special Report.

Descriptors: *Oil spills, *Water pollution effects, *Cleaning, Intertidal areas, Environmental effects, Aquatic life, Equipment, Operations, *Outer Continental Shelf, Brittany, AMOCO CADIZ.

The oil spill from the supertanker AMOCO Cadiz off the Brittany Coast of France overshadows by far any other oil spill into the marine environment. In terms of oil reaching the shore, it was on the order of four times the amount of the Torrey Canyon spill in the same general geographic area or the Metula spill in the Straits of Magellan. As a result, the spill and the subsequent activities to clean up the oil and mitigate damage provided a fascinating laboratory for those interested in institutional structure, planning, resource requirements, technology and training to deal with disasters of this magnitude. The physical properties, behavior, and movement of the oil and its ultimate deposition on the beaches is discussed in detail. The organizational structure established to deal with the spill and the strategy of control that appears to have been followed are presented and evaluated with regard to their utility in other spills. In addition the processes and unit operations used on the beaches are discussed. Estimates of the manpower and equipment used at different times throughout the spill are based on extensive reviews of newspaper reports and daily pollution reports issued by the Department of Equipment. The final section discusses what has been learned from this experience. (Sinha-OEIS)
W80-04082

IMPACT OF AN INTRODUCED FISH SPECIES (MORONE AMERICANA) ON THE FISHERIES RESOURCES OF NEBRASKA,
Nebraska Univ., Lincoln. Dept. of Forestry, Fisheries and Wildlife.
E. J. Peters, and R. Ballinger.
Available from the National Technical Information Service, Springfield, VA 22161 as PB80-158512, Price codes: A02 in paper copy, A01 in microfiche. Water Resources Center, University of Nebraska Technical Completion Report, March 1980, 13 p, 3 Fig, 2 Tab, 6 Ref. OWRT A-051-NEB (1), 14-34-0001-9029.

Descriptors: *White perch, *Fish establishment, *Saline lakes, *Nebraska, *Environmental effects, Fish populations, Fish physiology, Fish stocking, Number fish per acre, *Morone americana.

During the mid-1960's white perch (Morone americana) were evaluated as a possible species to be stocked in several saline lakes of the Sandhills of Nebraska. This possibility was abandoned after it was found that populations did not reach sizes suitable for fishing. White perch were removed and reservoirs restocked with more desirable species; however, a remnant population was discovered in Salt Creek. The objectives of this study were to: (1) document the extent of the white perch population in the Salt Creek drainage; and (2) study the dynamics of the Buckley 3F Reservoir population and determine its rate of spread downstream. Sections of creek downstream from Buckley 3F reservoir were seined and electrofished during 1978 and 1979. The population of white perch in Buckley Creek 3F Reservoir was sampled irregularly throughout 1978 and 1979 in order to determine population density, growth rate, spanwing time, mortality rate and food habits. To date no evidence of white perch has been found in the Little Blue River drainage outside of Buckley Creek 3F Reservoir. This includes sampling Buckley Creek immediately downstream from the reservoir. The final best estimate of white perch in Buckley Creek 3F Reservoir is 2,638, which is equivalent to 204 fish/hectare. White perch appear to be the most abundant fish species in the reservoir, comprising over 90% of the total number of fish captured.
W80-04109

ZOOPLANKTON IN AN UPWELLING AREA OFF NORTHWEST AFRICA: COMPOSITION, DISTRIBUTION AND ECOLOGY,
California Univ., San Diego, La Jolla. Inst. of Marine Resources.
M. Blackburn.
Deep Sea Research, Vol 26A, No 1, Part AA, p 41-56, January 1979. 3 Fig, 8 Tab, 28 Ref. NSF GX-33502 and OCE76-81172.

Descriptors: *Zooplankton, *Upwelling, *Africa, *Continental slope, *Continental shelf, Copepods, Distribution, Biomass, Ecology, Size, Predation, Advection, Distribution patterns, Spatial distribution, Secondary productivity, Dominant organisms, Systematics, Temporal distribution.

Mean zooplankton biomass increases from the inner continental shelf to the slope off northwest Africa, March-May 1974 in an upwelling area. The continental shelf is bounded by the 100-m isobath, beyond which there is a steep slope. Shelf biomass includes predominately small zooplankters between 0.1-0.5 mm, and slope biomass is predominately large animals > 1.0 mm. Organisms 0.5-1.0 mm make a small contribution to both. The inner shelf is a consistently poor area for zooplankton by comparison with the outer shelf and slope. Principal taxa by weight are Copepoda, Euphausiacea, Thaliacea and Coelenterata. Copepoda greatly predominate. Euphausiacea and Thaliacea are important only in the > 1.0mm group. Temporal changes in zooplankton biomass are moderate and mainly affect Copepoda and Thaliacea. Copepoda show more temporal change on the slope where they are mostly large than on the outer shelf where they are mostly small. Thaliacea change with time in the same way in both areas, which are occupied by the same population of large individuals. Estimated gains and losses to zooplankton from local biological conditions are much smaller than those from advection. In a 390 million sq m area across the outer shelf, where flow is almost always southward at all depths, daily change in biomass is estimated as follows: 10-50 billion g entering and leaving by advection, and 0.1-3.0 billion g entering and leaving as a result of local production and local fish predation. (Danovich-Wisconsin)
W80-04113

ADDITION OF NUTRIENTS TO A LAKE LEADS TO GREATLY INCREASED CATCH OF SALMON,
Fisheries and Marine Service, Nanaimo (British Columbia). Pacific Biological Station.
R. J. LeBrasseur, C. D. McAllister, and T. R. Parsons.
Environmental Conservation, Vol 6, No 3, p 187-190, Autumn 1979. 1 Fig, 1 Tab, 5 Ref.

Descriptors: *Fish harvest, *Salmon, *Nutrients, *Productivity, *Lakes, *Great Central Lake(British Columbia), *Fish farming, *Fertilization, Fish management, Fisheries, Sockeye salmon, Vancouver Island(British Columbia), Canada, Fertilizers, Phytoplankton, Fish populations, Fish establishment, Nutrient requirements, Spawning, Fish migration, Juvenile fish, Fish.

During 1969-1970 about 100 tons of fertilizer were applied to Great Central Lake, Vancouver Island in hope that dissolved nutrients would increase production of sockeye salmon (Oncorhynchus nerka). Experiment results were favorable; both animal and plant production in this oligotrophic lake increased. Average weight of young salmon increased by 30%. The number of juveniles surviving from spring emergence to November increased nearly threefold. The number of fish migrating back to Great Central Lake increased seven times over 1969 fish numbers. Experiment costs were $5 million. Gross value of the salmon catch over four years (1973-1976) was $14.1 million. Thus the apparent benefit from fertilizer application to the lake was $9 million. In addition the experiment was responsible for an increased number of spawners, whose progeny would support fishing four to five years later. The added fertilizer is known commercially as 27-14-0 (27% N, 14% P205, 0% K20) and has a nitrogen-to-phosphorus ratio of 10:1. An organic supplement in the form of fish solubles was also added in small amounts in 1969 in order to provide chelation for trace elements contained in the organic fertilizer. Timing of the nutrient additions was adjusted to coincide with warming of surface waters. (Harris-Wisconsin)
W80-04114

POST-WAR LAND DRAINAGE, FERTILIZER USE AND ENVIRONMENTAL IMPACT IN NORTHERN IRELAND,
New Univ. of Ulster, Coleraine (Northern Ireland). School of Biological and Environmental Studies.
For primary bibliographic entry see Field 4A.
W80-04115

SEASONAL CHANGES IN STRUCTURE OF A SUBMERGED BLUEGREEN ALGAL/BACTERIAL COMMUNITY FROM A GEOTHERMAL HOSTSPRING,
Texas Univ. at Arlington. Dept. of Biology.
W. R. Fagerberg, and H. J. Arnott.
Journal of Phycology, Vol 15, No 4, p 445-452, December 1979. 8 Fig, 2 Tab, 23 Ref.

Descriptors: *Cyanophyta, *Aquatic bacteria, *Thermal springs, *Mimbres(NM), *Seasonal, *Temporal distribution, Water temperature, Analytical techniques, Thermal water, Geothermal studies, Light quality, Aquatic plants, Freshwater algae, Biomass, Spatial distribution, Speciation, Bacteria, Algae, Light, Light intensity, Volume, New Mexico.

Seasonal changes in a submerged blue-green algal/bacterial community at geothermal hotsprings in Mimbres, New Mexico correlate with seasonal changes in light intensity and duration. The community receives three h sunlight/d. Light is severely restricted in fall when tree leaves accumulate on the water surface. Total mat volume occupied by living organisms never exceeds 2%; volume remains relatively constant from January to July then drops sharply in November. Most of the living mat volume is occupied by bacteria (99%). Density values show a slight but steady decrease from a January high of 16 individuals/1000 micro sq m to a November low of 10 individuals/1000 micro sq m. Maximal distribution values for both blue-green algae and bacteria occur during spring and summer months. Three dominant blue-green algal cytospecies which represent the greatest amount of biomass, alternate in their abundance on a seasonal basis while the three dominant bacterial cytospecies remain the same. Blue-green algal/bacterial mat communities occur within a gelatinous matrix that also contains gas and water bubble chambers. Water temperature in which the mats are submerged shows little change over the year. Stereological techniques were used to measure biomass, density, distribution and species diversity. (Harris-Wisconsin)
W80-04117

MULTIDATE LANDSAT LAKE QUALITY MONITORING PROGRAM,
Wisconsin Univ., Madison.
For primary bibliographic entry see Field 7B.
W80-04118

SKELETONEMA POTAMOS (WEBER) HASLE AND CYCLOTELLA ATOMUS HUSTEDT (BACILLARIOPHYCEAE) IN THE PLANKTON OF RIVERS IN ENGLAND AND FRANCE,
Institute of Terrestrial Ecology, Cambridge (England); and Culture Centre of Algae and Protozoa,

Cambridge (England).
For primary bibliographic entry see Field 2I.
W80-04120

APPLYING PHOSPHORUS LOADING MODELS TO EMBAYMENTS,
National Oceanic and Atmospheric Administration, Ann Arbor, MI. Great Lakes Environmental Research Lab.
For primary bibliographic entry see Field 5B.
W80-04123

THE UPTAKE OF UREA BY CHLORELLA,
University Coll. of Swansea (Wales). Dept. of Botany and Microbiology.
I. A. Bekheet, and P. J. Syrett.
The New Phytologist, Vol 82, No 1, p 179-186, January 1979. 4 Fig, 5 Tab, 6 Ref.

Descriptors: *Chlorella, *Kinetics, *Ureas, *Marking techniques, Algae, Chlorophyta, Nutrients, Cytological studies, Metabolism, Tracers, Radioactivity techniques, Photosynthesis, Light, Darkness, Nutrient requirements, Cycling nutrients, Chromatography, Radioisotopes, Analytical techniques.

Experiments show that light stimulates uptake rates of radioactive urea by Chlorella. C-14 contained in radioactivated urea is taken up rapidly by urea-grown Chlorella cells. Uptake rates are considerably greater than those attained by passive diffusion and are much more rapid in light than in darkness. Uptake rates relate to urea concentration hyperbolically and K-m is 16.5 micro M. However, examination casts doubt on what is being measured when C-14 is taken up from (C-14) urea. After five minutes, only 45% of C-14 taken up is recovered in urea; moreover, although C-14 uptake rates are much lower in darkness than in light, rates at which C-14 disappear from the medium are not very much different. DCMU, an inhibitor of photosynthetic carbon dioxide fixation, inhibits markedly C-14 uptake in light. These findings strongly suggest that Chlorella metabolizes C-14 urea rapidly in either light or in darkness with carbon dioxide production which, in light, is converted to organic compounds by photosynthesis. Nevertheless, light stimulates urea uptake as shown when (C-14) urea in cells is extracted and separated by thin-layer chromatography. Since C-14 uptake is inhibited competitively by thiourea and (C-14) urea metabolism occurs so rapidly, it may be preferable to study Chlorella uptake mechanisms by using thiourea. (Danovich-Wisconsin)
W80-04124

THE POTENTIAL EFFECTS OF ENERGY RELATED ACTIVITIES ON THE SEASONAL TRAJECTORIES OF EPIPHYTIC MARINE DIATOMS,
City Univ. of New York. Dept. of Biology.
G. F. Coccetti, and J. J. Lee.
Hydrobiologia, Vol 67, No 1, p 51-80, November 1979. 9 Fig, 8 Tab, 44 Ref. ERDA E(11-1)3254, (C00)3254-28.

Descriptors: *Biological communities, *Diatoms, *Succession, *Niches, Cultures, Speciation, Ecology, Growth rates, Heavy metals, Oil, Algae, Plant groupings, Statistics, Seasonal, Epiphytes, Water quality, Sippewisset Marsh(MA), Jamaica Bay(NY), Southampton(NY), New York, Massachusetts.

Seasonal successional trajectories measured summer 1973 show that each species of transplanted and experimental diatom communities has a definable niche and if all experimental factors are equal, niches are expressions of competition pressures, synergisms and antagonisms exerted by coexisting community members. Very few generalizations could be made about individual species' behavior in any particular experiment. Diatom assemblages were manipulated at Sippewisset Marsh, Massachusetts, by an in-situ experimental apparatus capable of incubating these organisms without doing violence to the community itself. Epiphytic diatom community assemblages were taken from Jamaica Bay and Southampton, New York and from Sippewisset Marsh. A mixture of the inocula was also made and the effects of Fe, Cu, Cr, Pb, Zn and crude oil was tested. Since random environmental fluctuations were constant for all assemblages, individual species abundance was due to niche packing and interspecific restraints as well as changes in water quality. Twice as many species (40%) had their greatest niche breadth in the mixed community as did species in transplanted (20%) or native controls (17%). Medium enrichment with heavy metals and oil altered community structure and diversity. Cu and Cr assemblages initially followed oil and Pb trajectories but diverged later. Greatest species diversity occurred with Cu incubations. Fe enriched communities generally diverged from all the others. (Danovich-Wisconsin)
W80-04125

DISTRIBUTION OF POLLUTANTS FROM A NEW PAPER PLANT IN SOUTHERN LAKE CHAMPLAIN, VERMONT AND NEW YORK,
Michigan Univ., Ann Arbor. Dept. of Natural Resources.
For primary bibliographic entry see Field 5B.
W80-04126

NUMERICAL ABUNDANCE AND BIOMASS OF BACTERIA, ALGAE AND MACROBENTHOS OF A LARGE NORTHERN RIVER, THE ATHABASCA,
Waterloo Univ. (Ontario). Dept. of Biology.
D. R. Barton, and M. A. Lock.
Internationale Revue der Gesamten Hydrobiolgie, Vol 64, No 3, p 345-359, 1979. 6 Fig, 1 Tab, 42 Ref.

Descriptors: *Athabasca River(Alberta, Canada), *Bacteria, *Algae, *Benthos, *Sampling, Canada, Speciation, Biomass, Chlorophyll-a, Standing crop, Invertebrates, Diptera, River beds, Rivers, Seasonal, Sediments, Substrates, Sands, Mud, Particle size, Distribution, Spatial distribution.

Autumnal direct sampling of Athabasca River (northern Alberta, Canada) macrobenthos shows that bedrock fauna is similar in composition and numerical density to that reported from smaller streams, while a group of specialized chironomid larvae dominates the fauna of sand and mud. Invertebrate biomass is similar on coarse sand and mud and lower on fine sand. Numerical standing stocks show a decreasing order from coarse sand to mud to muddy sand to medium sand to fine sand. Larvae of an undescribed species of Parakiefferiella dominates coarse sand fauna. On bedrock, invertebrate biomass and sessile bacteria abundance are greatest close to the water's edge and at 3 m depth. Bacterial densities are within ranges for rocks in similar streams. Chlorophyll-a standing crop at 1.5 m is about one-half that found at 0.25 m. ATP levels are closely associated with numbers of small invertebrates (less than 6 mm) but not with bacteria or algae biomass. Benthic primary production probably contributes organic matter to the river, but is probably limited by rapid light attenuation due to extended periods of high turbidity during the open water season. Most of the energy available to benthic communities is probably allocthonous in origin. The average width of the river near Fort MacKay where sampling was done is about 400 m, main channel depth is at least 4.5 m during the open water season, and discharge ranges from 200 cu m/sec in winter to over 1700 cu m/sec in summer. (Harris-Wisconsin)
W80-04127

VOLATILE ORGANIC SULFIDES FROM FRESHWATER ALGAE,
Washington State Univ., Pullman. Dept. of Botany.
M. J. Bechard, and W. R. Rayburn.
Journal of Phycology, Vol 15, No 4, p 379-383, December 1979. 2 Fig, 2 Tab, 19 Ref.

Descriptors: *Cyanophyta, *Freshwater, *Sulfur compounds, *Ecology, *Dimethyl sulfide, *Valley Road Pond(WA), Sulfur, Sulfides, Chlorophyta, Diatoms, Chrysophyta, Xanthophyta, Microenvironment, Gas chromatography, Sulfur bacteria, Speciation, Microbiology, Gases, Cultures, Eutrophication, Laboratory tests, Aquatic algae.

This study suggests that dimethyl sulfide (DMS) is the principle atmospheric sulfur carrier in freshwater ecosystems which support large communities of filamentous green and blue-green algae. DSM concentrations measured April-September 1973, ranged from trace amounts in spring and fall to 70,000 Ng/l in summer in Valley Road Pond, near Pullman, Washington. Highest DMS concentrations occur when Nostoc are abundant and Spirogyra and Oedogonium mats are decaying. Gas chromatography analysis of nonaxenic cultures of Nostoc alone show it produces only small DMS amounts. Analyses of Oedogonium and Spirogyra, young and old cultures indicate that hydrogen sulfide (H2S), DMS and dimethyl disulfide (DMDS) occur only in senescent cultures. Bacterial contamination reduction in these cultures with penicillin G results in no detectable sulfur production. Algal axenic cultures not endemic to the pond were also analyzed. Six Cyanophyta species produce DMS and DMDS. Two produce methyl mercaptan. Chlorophyta, Xanthophyta and Bacillariophyta do not produce detectable sulfur compounds. Therefore, sources of DMS depend on algal community composition. In freshwater ecosystems which support large Chlorophyta, Xanthophyta and Bacillariophyta populations, DMS is probably not algal in origin. Rather, it is bacterial in origin with decaying algae acting as a substrate for bacterial growth. In freshwater ecosystems with Cyanophyta dominating, DMS is not only bacterial in origin but it is also synthesized directly by blue-green algae. (Danovich-Wisconsin)
W80-04128

SOME PHOTOSYNTHETIC CARBON FIXATION PROPERTIES OF SEAGRASSES,
Tel Aviv Univ. (Israel). Dept. of Botany.
S. Beer, and Y. Waisel.
Aquatic Botany, Vol 7, No 2, p 129-138, October 1979. 5 Fig, 1 Tab, 12 Ref.

Descriptors: *Marine algae, *Photosynthesis, *Carbon dioxide, *Plant physiology, *Carbonates, Carbon, Red Sea, Mediterranean Sea, Tracers, Chloropyyll, Speciation, Cymodocea nodosa, Halophila ovalis, Enzymes, Laboratory tests, Ecology, Adaptation, Biochemistry, Sea water, Israel.

The main exogenous carbon form utilized by seagrass species is HC03-; this agrees well with high HC03- concentrations found in seawater compared with C02 concentrations. The former concentration at 2.5 mM is saturating for photosynthesis in these plants. One Mediterranean seagrass species, Cymodocea nodosa, and three Red Sea species, Halophila ovalis, H. uninervis and Syringodium isoetifolium were used in experiments. C. nodosa and H. ovalis net photosynthetic rates at saturating HC03- concentrations are 0.4 and 0.05 micro moles 02/min mg chl, respectively. When additional C02 is added, photosynthetic rates increase. In C. nodosa, photosynthetic rates are three times higher at saturating C02 concentrations than at saturating HC03- concentrations. In H. ovalis, photosynthetic rates are similar at saturating concentrations of both carbon forms. Whether HC03- is fixed directly by phosphoenolpyruvate carboxylase or transformed to C02 and fixed by ribulosebiphosphate carboxylase probably depends on the levels of these and other enzymes as well as which carbon form is available. C14 pulse-chase experiments show that H. uninervis and S. isoetifolium are C3 plants, even though they posses features indicating C4 metabolism. These plants are unlike Thalassia testudinum, shown earlier to be a C4 plant. Variations in photosynthetic pathways reflect an ability of seagrasses to adapt to various ecological conditions. (Danovich-Wisconsin)
W80-04129

PRIMARY PRODUCTION OF ALGAE GROWING ON NATURAL AND ARTIFICIAL AQUATIC PLANTS: A STUDY OF INTERACTIONS BETWEEN EPIPHYTES AND THEIR SUBSTRATE,
McGill Univ., Montreal (Quebec). Dept. of Biology.
For primary bibliographic entry see Field 2I.
W80-04131

ORIGINS OF OCEANIC PLANKTON IN THE MIDDLE ATLANTIC BLIGHT,
California Univ., Santa Barbara. Marine Science Inst.
For primary bibliographic entry see Field 2L.
W80-04132

EPIPELIC AND EPILITHIC DIATOM ASSEMBLAGES IN MONTEZUMA WELL NATIONAL MONUMENT, ARIZONA,
Minnesota Univ., St. Paul. Dept. of Botany.
D. B. Czarnecki.
Journal of Phycology, Vol 15, No 4, p 346-352, December 1979. 3 Fig, 2 Tab, 26 Ref.

Descriptors: *Diatoms, *Montezuma Well National Monument(AZ), *Biological communities, *Benthic flora, *Correlation analysis, Speciation, Systematics, Seasonal, Light intensity, Biomass, Water chemistry, Epilithic, Epipelic, Sediments, Achnanthes, Cocconeis, Cyclotella, Fragilaria, Rhiocosphenia, Synedra, Statistics.

Epipelic assemblages at Montezuma Well National Monument, Arizona, measured May 1976-April 1977, show a tri-dominant association of Cyclotella pseudostelligera, Cocconeis placentula and Achnanthes linearis. Epilithic assemblages are also tridominant: Rhoicosphenia curvata, C. pseudostelligera and Synedra ulna. Of the 83 diatom taxa observed, 51 are common to both assemblages, 24 are restricted to the epipelon and eight to the epilothon. C. pseudostelligera clearly dominates the epipelon throughout most of the year, ranging 74.6%-12% in relative abundance. The epilithon is clearly dominated by R. curvata, ranging 61%-10% in relative abundance. Based on seasonal abundance patterns, C. pseudostelligera and S. ulna outcompete other taxa during high light intensity and duration periods, while Fragilaris construens responds more favorably under low light intensity and duration. A. linearis, R. curavata and C. placentula are more tolerant of a wide range of light intensities and durations. On a yearly basis, both assemblages exhibit slight similarity. Mean diversity values and similarity indices are unacceptable when comparing assemblages with few highly abundant taxa. The use of dissimilarity indices are recommended. Montezuma Well National Monument, located 80 km south of Flagstaff, is a circular limestone depression 0.76 ha and 6.7 m deep. The system exhibits nearly constant nutrient levels and an unusually high free C02 content (690 mg/l). (Danovich-Wisconsin)
W80-04133

PHYSIOLOGICAL ASPECTS OF PRIMARY PRODUCTION IN SEAGRASSES,
Gatty Marine Lab., St. Andrews (England).
For primary bibliographic entry see Field 2L.
W80-04134

SPATIAL AND TEMPORAL PATTERNS OF TEMPERATURE, ALKALINITY, DISSOLVED OXYGEN AND CONDUCTIVITY IN AN OLIGO-MESOTROPHIC, DEEP-STORAGE RESERVOIR IN CENTRAL TEXAS,
Southwest Texas State Univ., San Marcos. Aquatic Station.
H. H. Hannan, I. R. Fuchs, and D. C. Whitenberg.
Hydrobiologia, Vol 66, No 3, p 209-221, October 1979. 12 Fig, 23 Ref.

Descriptors: *Canyon Lake(TX), *Stratification, *Dissolved oxygen, *Conductivity, *Alkalinity, *Spatial distribution, *Trophic levels, Reservoirs, Epilimnion, Seasonal, Anaerobic conditions, Temporal distribution, Water temperature, Turbidity, Impounded waters, Physicochemical properties, Physical properties, Chemical properties, Hypolimnion, Carbonates, Environmental effects.

Physicochemical analyses of impounded waters in Canyon Lake, Texas, February 1976-January 1977 show that transparency increases and surface bicarbonate alkalinity and conductivity decrease with distance down reservoir. Greater turbidity at riverine stations is caused by greater plankton quantities and heavier silt loads. Transparency fluctuations in the reservoir are due to plankton population fluctuations. Riverine stations exhibit a wider temperature range than reservoir waters. Thermal stratification is sufficiently established by June to develop an anoxic hypolimnion. Epilimnion depth increases and hypolimnion waters continue to warm through September. Increased epilimnion depth is caused by withdrawal of cold water from the hypolimnion. Epilimnion alkalinity decreases during summer as a result of photosynthetic bicarbonate uptake. Hypolimnetic alkalinity increases are due to increases in carbon dioxide from decomposition. Bicarbonate concentrations decrease 16-31% with distance through the reservoir; this is caused by bicarbonate utilization in primary phytoplankton productivity. A downstream pattern of hypolimnetic oxygen depletion was observed. Oxygen concentrations less than 1 mg/l occur in upstream sections in June and near the dam in August; this is due to smaller hypolimnetic volume and greater input of oxidizable sediments in upstream areas. Specific conductance exhibits temporal and spatial variations similar to those of bicarbonate and calcium, the predominant ionic species. (Danovich-Wisconsin)
W80-04135

UPTAKE AND RELEASE OF NUTRIENTS BY AQUATIC MACROPHYTES,
Mankato State Univ., MN. Dept. of Biology.
B. H. Hill.
Aquatic Botany, Vol 7, No 1, p 87-93, September 1979. 2 Fig, 24 Ref.

Descriptors: *Aquatic plants, *Cycling nutrients, *Agricultural runoff, *Macrophytes, *Pondweeds, *Kinetics, Potamogeton nodosus, Potamogeton pectinatus, Potamogeton crispus, Nitrogen, Phosphorus, Carbon, Nutrients, Organic matter, Biodegradation, Degradation(Decomposition), Decomposing organic matter, Biomass, Minnesota, Drainage area, Organic matter, Organic compounds, Nutrient budgets.

Analysis of three aquatic macrophytes species, Potamogeton nodosus, P. pectinatus and P. crispus, from an agricultural drainage ditch in south-central Minnesota during the 1976 growing season shows similar nutrient accumulation and breakdown among species and sites. Nitrogen and phosphorus contents of the aquatic macrophytes are highest at the beginning of the growing season and gradually declined throughout the season. Peak biomass is 336 dwt/sq m for all three species combined. Accumulated nutrients total 5.65 g dwt/sq m for nitrogen and 1.29 g dwt/sq m for phosphorus. Average nutrient values for three species combined are 26.59 mg N/g dwt, 5.89 mg P/g dwt, and 353.7 mg C/g dwt. Species specific breakdown rates and nutrient concentrations are given for P. nodosus only; breakdown rates are 0.0312/d and 0.0408/d at two different sites. Nutrient concentrations remain relatively constant throughout the study. Carbon to nitrogen ratios range from 13.1:1 to 16.2:1. (Harris-Wisconsin)
W80-04136

TURBULENCE AND PHYTOPLANKTON DIVERSITY: A GENERAL MODEL OF THE 'PARADOX OF PLANKTON',
Maryland Univ., Cambridge. Horn Point Environmental Lab.
W. M. Kemp, and W. J. Mitsch.
Ecological Modelling, Vol 7, No 3, p 201-222, September 1979. 9 Fig, 3 Tab, 68 Ref.

Descriptors: *Mathematical models, *Phytoplankton, *Species diversity, *Turbulence, *Simulation analysis, *Population dynamics, Speciation, Ecology, Movement, Water circulation, Competition, Niches, Ecological distribution, Nutrients, Limiting factors, Growth rates, Life history studies, Flow, Hydrobiology, Environmental effects, Turnovers.

Simulation results from a mathematical model investigating the effects of both advective and turbulent water movements on the growth of three competing phytoplankton species, show that coexistence of all three species occurs only under turbulent regimes. Plankton diversity is maintained through metabolic responses to a randomly-fluctuating, turbulent environment. Simulataneous coexistence of all three species also occurs only when the primary period of turbulent events is one day, close to turnover rates for phytoplankton populations. In the absence of water motion, no two species are able to coexist, while under hypothetical advection conditions without turbulence (laminar flow) just two species occur contemporaneously. The 'paradox of plankton' states that a diverse array of phytoplankton species invariably coexist. However, the principle of competitive exclusion states that the species with greatest competitive advantage for a given ecological niche utilize environmental resources associated with that niche to such an extent that no other organism simultaneously occupies the same niche. The aquatic medium in which phytoplankton live is continuously being mixed by turbulent eddies. The model investigates possible relationships between phytoplankton diversity and hydrodynamic turbulence in natural waters. Diversity amongst species which compete for the same niche require an environment which fluctuates with a periodicity approaching turnover times for those species; phytoplankton turnover ranges 0.5-5 days. (Danovich-Wisconsin)
W80-04138

BUOYANCY OF NATURAL POPULATIONS OF MARINE PHYTOPLANKTON,
Bergen Univ. (Norway). Inst. of Marine Biology.
C. Lannergren.
Marine Biology, Vol 4, No 1, p 1-10, 1979. 6 Fig, 2 Tab, 18 Ref.

Descriptors: *Buoyancy, *Phytoplankton, *Diatoms, *Floating, *Vertical migration, Population, Fjords, Physical properties, Marine algae, Density, Cytological studies, Nutrients, Aging(Biological), Chlorophyll, Bergen(Norway), On-site data collections, On-site investigations, Growth stages, Population dynamics, Distribution, Norway.

Positive buoyancy was observed only once in a diatom spring bloom, February-April 1977 in a fjord near Bergen, Norway. The investigation was carried out with natural phytoplankton populations under approximate in-situ conditions. Buoyancy was studied in 2.2 m long, transparent Plexiglas tube filled with sea water. The paper concentrates on a diatom spring bloom, but also includes results from a 1976 flagellate-dominated autumn bloom. Positive buoyancy, observed once, is associated with intense growth in the initial bloom phase. Neutral buoyancy occurs on some occasions in the first phase of the bloom, while negative buoyancy occurs in most experiments. Mean sinking rates for the entire chlorophyll content vary 0.3-2.2 m/d. Sinking rates for individual fractions range 0-9 m/d. Results show higher sinking rates in the post-bloom period, indicating that either senescent cells sink faster than actively growing cells or that cells adapt to changing nutrient concentrations. Skeletonema costatum and Chaetoceros dominate the spring bloom. In autumn blooms dominated by coccolithophorids and small, athecate flagellates, positive buoyancy occurs in two out of three cases. As these algae are small and motile, vertical distribution is probably little influenced by sinking. High nutrient concentrations permit growth of large diatoms which, apart from a short period, have comparatively high sinking rates, while low concentrations favor dominance of small flagellates with low or negligible sinking rates. (Danovich-Wisconsin)
W80-04139

IN SITU MEASUREMENTS OF NET PRIMARY PRODUCTION IN A COLORADO MOUNTAIN STREAM,
Colorado Univ., Boulder. Dept. of Environmental, Population, and Organismic Biology.
R. W. Pennak, and J. W. Lavelle.
Hydrobiologia, Vol 66, No 3, p 227-235, October 1979. 3 Fig, 4 Tab, 40 Ref.

Descriptors: *Primary productivity, *Streambeds, *On-site investigations, *Arkansas River(CO), Photosynthesis, Metabolism, Streams, Heterotrophy, Biological communities, Mountains, On-site data collections, Respiration, Seasonal, Water

temperature, Water chemistry, Autotrophy, Benthos, Biomass.

Net primary productivity of the bottom community ranged from -27.38 to 35.59 g C/sq m yr, indicating a range of heterotrophy to autotrophy in the Arkansas River, an unpolluted Colorado whitewater stream 1452-2835 m a.s.l., November 1965-1966. Four stations vary between heterotrophy and autotrophy at different times. One station exhibits only heterotrophy; it is unpolluted and located just above the city of Salida in the foothills of the Rocky Mountains. One station exhibits only autotrophy; it is located just upstream from Pueblo in the plains region east of the mountains. Negative primary productivity readings reflect overall dominating heterotrophic conditions; algal respiration and action of bacteria and fungi on organic detritus substrate more than balance algal photosynthesis so there is a net dissolved oxygen loss after 24 hr. There are no seasonal trends and no correlations with water temperature and chemistry. Bottom fauns biomass does not correlate with net community productivity. Five stations have poor biomass with less than 10 g wet wt/sq m, whereas Salida station biomass averages 144 g/sq m. Dissolved oxygen and water temperature are electronically monitored in an undisturbed section of rubble bottom enclosed by a large plastic dome set into the substrate. The entire chamber was completely filled with stream water and set below stream water level. Water in the dome is circulated rapidly by a small submerged electric pump. (Danovich-Wisconsin)
W80-04140

ANALYSIS OF HETEROTROPHIC MICROPLANKTON IN AN UPWELLING AREA,
Akademiya Nauk SSSR, Moscow. Inst. Okeanologii.
Y. I. Sorokin, and J. E. Kogelschatz.
Hydrobiologia, Vol 66, No 3, p 195-208, October 1979. 10 Fig, 6 Tab, 20 Ref.

Descriptors: *Upwelling, *Microorganisms, *Primary productivity, *Heterotrophy, *Punta San Juan, Peru, *Marine algae, Biomass, Bacteria, Phytoplankton, Gymnodinium, Mesodinium, Respiration, Organic matter, Protozoa, Red tide, Dinoflagellates, Density, Nutrients, Growth rates.

In freshly upwelled water in the Punta San Juan region off Peru, April-May 1977, the main component of the planktonic community were microheterotrophs, the development of which precede that of phytoplankton because of independence of the stability of water mass and light conditions. Microheterotroph respiration exceeds by threefold primary photoplankton production. During the movement of upwelled water, biomass increases 1000 times in four days. Near the bloom, biomass in 10 g wet wt/cu m and primary production is 8.6 g C/sq m d, close to maximum for natural oceanic plankton communities. Values of P/B coefficients of phytoplankton reach 7-10/d. Analyses reveal a rich microheterotroph population in the center of upwelling. Bacteria numbers reach 0.3-0.7 million/ml and biomass 10-50 mg C/cu m. Microbial production here is 5-15 mg C/cu m d. Protozoa also flourish in the center of upwelling; wet biomass reaches 1 g/cu m, the highest concentration of protozoa ever recorded in seawater. Dominating species include Strombidium ciliates and various tintinnids. During transects normal to the coast line, abundant dinoflagellate populations (5-40 thousand/l) of Gymnodium and Prorocentrum are found in anoxic waters 50-100 m. In an area over the shelf break and continental slope, a red tide was caused by an intense bloom of ciliate Mesodimium rubrum. This ciliate is a functional autotroph that harbors pseudosymbiotic chloroplasts of cryptomonad origin. Biomass reached 50-70 g wet wt/cu m and cell density 2-4 million/l at the surface. (Danovich-Wisconsin)
W80-04145

PHOTOSYNTHETIC CARBOXYLATING ENZYMES IN MARINE PHYTOPLANKTON,
Bigelow Lab. for Ocean Sciences, West Boothbay Harbor, ME.
H. E. Glover, and I. Morris.
Limnology and Oceanography, Vol 24, No 3, p 510-519, May, 1979. 7 Fig, 2 Tab, 27 Ref. NSF OCE 77-08722.

Descriptors: *Enzymes, *Biochemistry, *Photosynthesis, *Marine algae, *Phytoplankton, *Primary productivity, Marine microorganisms, Cultures, Laboratory tests, Population, Correlation analysis, Algae, Cytological studies, Analytical techniques, Sea water, Metabolism, Plant physiology, Chemical reactions, Gulf of Maine, Assay, Bioassay.

Data from both cultures and natural marine phytoplankton populations show that carbon fixed by photosynthesis is always greater than that fixed by ribulose-l, 5-besphosphate carboxylase (RUBPCase) and phosphoenolpyruvate carboxylase (PEPCase). Therefore, instantaneous measurement of those carboxylating enzymes does not indicate potential photosynthetic capacity. When RUBP is solubilized it rapidly breaks down and forms products which may inhibit RUBPCase activity. Alternatively, the difference between carboxylase activity and photosynthesis may reflect reactions during assimilation of (C-14) bicarbonate by whole cells and not included in enzymatic assays. The ratio of carbon fixation by whole cells (P-max) to that by carboxylating enzymes such as RUBPCase and PEPCase is not constant. The ratio may indicate the cell's physiological state since it is greatest when photosynthetic rate is highest. The discrepancy between photosynthesis and carboxylase activity is significantly greater in natural populations than in all cultures examined. PEPCase is quantitatively important only when photosynthetic rate is low. The lack of a significant correlation between P-max and RUBPCase:PEPCase ratio in natural populations is probably due to species differences, since Dunaliella has a 29.2 ratio when P-max is high while chrysophyte and diatom cultures have ratios ranging from an eighth to half this value. Water samples were collected from Gulf of Maine and Boothbay Harbor, Maine, December 1977-July 1978; six different algal species were used in the cultures. (Danovich-Wisconsin)
W80-04146

GROWTH, CHLOROPHYLL AND MINERAL NUTRIENT STUDIES ON PHALARIS ARUNDINACEAE L. IN THREE SCOTTISH LOCHS,
Dundee Univ. (Scotland). Dept. of Biological Sciences.
Y. B. Ho.
Hydrobiologia, Vol 63, No 1, p 33-43, March 1979. 11 Fig, 6 Tab, 15 Ref.

Descriptors: *Aquatic plants, *Chemical analysis, *Plant growth, *Chlorophyll, *Scotland, Lakes, Phalaris arundinaceae, Forfar Loch(Scotland), Balgavies Loch(Scotland), Loch of the Lowes(Scotland), Growth rates, Plant tissues, Nutrients, Leaves, Root development, Trophic level, Sewage effluents, Standing crops, Seasonal, Biochemistry, Plant physiology, Plant morphology.

During the 1975 growing season, general growth characteristics, chlorophyll content and mineral level were analyzed in reed canary-grass, Phalaris arundinaceae, growing in three shallow lowland Scottish lochs, Forfar Loch (polytrophic), Balgavies (eutrophic) and Loch of the Lowes (mesotrophic). Average maximum shoot heights (160 cm) are similar in all three lochs. Phalaris standing crops are 1151 g dwt/sq m in Forfar, 405 g dwt/sq m in Balgavies, and 440 g dwt/sq m in Lowes. Maximum chlorophyll contents in all three lochs is 8-9 mg/g dwt leaf. Leaf chlorophyll contents peaks twice; the first occurs late April in all three lochs. The second occurs June-July in Balgavies and Lowes while in Forfar it occurs July-August. Chlorophyll content steadily decreases for the rest of the growing season. Some shoot minerals reach maximum in summer and then remain constant for the rest of the season. This pattern applies to C, P, Na and Fe for plants in all lochs, as well as K, Ca and Mg for Balgavies and Lowes plants, indicating mainerals are retained and not released before tissue degradation. The second mineral distribution pattern involves a large decline after summer peak. Nitrogen in all lochs and K, Ca and Mg in Forfar plants follow this second pattern. Forfar shoots also contain a disproportionately greater amount of N, P, Na and Fe compared with the other two lochs; this is probably due to enrichment from sewage effluents. (Danovich-Wisconsin)
W80-04147

PRIMARY PRODUCTION AND BACTERIOPLANKTON IN FISH PONDS WITH MONO AND POLY-CULTURE,
Kalyani Univ. (India). Dept. of Zoology.
B. B. Jana.
Hydrobiologia, Vol 62, No 1, p 81-87, January 1979. 1 Fig, 5 Tab, 10 Ref.

Descriptors: *Primary productivity, *Bacteria, USSR, *Fish Farm Nivka(USSR), Kiev(USSR), *Fish farming, Summer, Plankton, Fish, Carp, Water temperature, Biochemical oxygen demand, Seasonal, Heterotrophy, Population, Respiration, Photosynthesis, Correlation analysis, Grazing, Fish food organisms, Speciation.

No definite relationship exists between primary productivity and bacterioplankton in three fish ponds with mono-/and polyculture in the Fish Farm Nivka, Kiev, USSR, May-September 1975; this probably results from the low percentage of autotrophic photosynthetic bacteria and abundance of heterotrophic bacteria. Biochemical oxygen demand directly correlates with oxygen respiration losses due to bacterial populations however, biochemical oxygen demand does not correlate with total bacterioplankton population. Net photosynthetic oxygen production over 24 h is very small in ponds with mono-/and polyculture, indicating that phytoplanktonic algae are being heavily grazed by herbivorous fishes. Primary production in terms of oxygen release are not pond specific even though fish culture practices differ. Gross primary production averages are 21.54 Kcal/sq m (monoculture), and 22.00-24.09 Kcal/sq m (polyculture). Maximal oxygen production occurs in July; this is coupled with increasing water temperature. Values then tend to decline and reach a minimum in September. Monoculture ponds contain only common carp, whereas common carp (Cyprinus carpio), silver carp (Hypophthalmichthys molitrix), grass carp (Ctenopharyngodon idella) and big heads (Aristicthys nobilis) are reared in polyculture ponds. (Danovich-Wisconsin)
W80-04148

PHYTOPLANKTON MODELING INVOLVING RANDOM RATE CONSTANTS. PART I: DETERMINISTIC SETTING,
American Univ., Washington, DC.
R. W. Jernigan, and C. P. Tsokos.
The International Journal of Environmental Studies, Vol 14, No 2, p 97-105, 1979. 4 Fig, 15 Ref.

Descriptors: *Phytoplankton, *Model studies, *Primary productivity, *Ecosystems, Sea water, Nutrients, Zooplankton, Stochastic processes, Light intensity, Temperature, Absorption, Predation, Spatial distribution, Euphotic zone, Numerical analysis.

A system of nonlinear deterministic differential equations describe the flow of chemical nutrients through three components of a marine ecosystem, the phytoplankton, zooplankton and stock nutrient in the euphotic zone. The biological activities considered include: nutrient absorption by phytoplankton, extracellular release by phytoplankton, predation by zooplankton, and death and excretion of zooplankton. The parameters governing these activities, such as rates of nutrient uptake, zooplankton excretion and predation, were determined. Light and temperature fluctuations, spatial distributions of organisms, and detritus as the source of zooplankton food were not considered in the model. Through the use of numerical solutions and graphical presentations, the behavior of the model was studied. The most prominent characteristic of the model was the dampened oscillatory behavior of predatory-prey systems. Several parameter configurations were examined to determine their effect on the solutions. It was found that large values of the nutrient uptake coefficient, extracellular release rate and zooplankton death rate, increased the model's oscillatory behavior. The linear deterministic system was also developed in the study. (Harris-Wisconsin)

W80-04151

GROWTH AND POPULATION STUDIES ON TILAPIA GALILAEA IN LAKE KINNERET,
Israel Oceanographic and Limnological Research Ltd., Haifa.
For primary bibliographic entry see Field 5G.
W80-04152

PRODUCTION OF VITAMIN B12, THIAMINE, AND BIOTIN BY FRESHWATER PHYTOPLANKTON,
Kochi Univ. (Japan). Faculty of Agriculture.
For primary bibliographic entry see Field 2H.
W80-04169

DISTRIBUTION AND QUANTITATIVE DEVELOPMENT OF AQUATIC MACROPHYTES IN RELATION TO SEDIMENT CHARACTERISTICS IN OLIGOTROPHIC LAKE KALGAARD, DENMARK,
Copenhagen Univ., Hillerod (Denmark). Freshwater Biological Lab.
K. Sand-Jensen, and M. Sondergaard.
Freshwater Biology, Vol 9, No 1, p 1-11, February, 1979. 10 Fig, 6 Tab, 40 Ref.

Descriptors: *Oligotrophy, *Distribution, *Lake Kalgaard(Denmark), *Aquatic plants, *Sediments, *Organic matter, *Submerged plants, Macrophytes, Biomass, Speciation, Nutrients, Carbon dioxide, Adaptation, Ecology, Photosynthesis, Light intensity, Nitrogen, Plant physiology, Organic soils, Organic compounds, Phosphorus, Inorganic compounds, *Denmark.

An increasing sediment organic content at 0-0.75 m depth in Lake Kalgaard, Denmark creates a physiologically richer medium for isoetid plant species. Vegetational biomass, above-ground biomass fraction, and individual plant weight all increase with sediment organic content. At the same time, interstitial carbon dioxide, extractable inorganic nitrogen and exchangeable phosphorus concentrations increase. Kalgaard, a small, 10.5 ha lake with 4.65 m mean depth, was examined October 1975-October 1977. Vegetation is dominated by submerged isoetid species. Emergent and floating-leaved macrophytes are confined to sheltered lake parts with high organic sediments. Submerged species have a high cover area and biomass: Littorella uniflora forms compact stands with 112 g organic dwt/sq m mean biomass; Isoetes lacustris shoots are more scattered but attain 66 g organic dwt/sq m mean biomass. These two species account for 99% of the submerged macrophyte biomass. Littorella dominates 0-2 m zone and Isoetes dominates the 2-4.5 m zone. Littorella has a higher photosynthetic capacity (23 micro g 02/sq cm h) than Isoetes (19.5 micro g 02/sq cm h) at 15C and saturating irradiance. Littorella biomass seasonal variation is small. Lake Kalgaard has only 2.2-2.5 mg N/l. Rosette growth form and great below-ground isoetid biomass (20-65%) are seen as adaptations to oligotrophic ecological conditions such as low inorganic carbon and nutrient concentrations in the water. (Danovich-Wisconsin)
W80-04172

WATER QUALITY AND MINING: A MANAGEMENT PLAN.
North Carolina Dept. of Natural Resources and Community Development, Raleigh. Div. of Environmental Management.
For primary bibliographic entry see Field 5G.
W80-04180

DOMESTIC WATER SUPPLIES, HEALTH AND POVERTY: A BRIEF REVIEW,
For primary bibliographic entry see Field 6D.
W80-04183

MAN-INDUCED MODIFICATIONS IN ESTUARIES OF THE NORTHERN GULF OF MEXICO: THEIR IMPACTS ON FISHERY RESOURCES AND MEASURES OF MITIGATION,
Bureau of Land Management, Albuquerque, NM.
R. A. Diener.
In: The Mitigation Symposium: a National Workshop on Mitigating Losses of Fish and Wildlife Habitats, held Fort Collins, CO on July 16-20, 1979. Forest Service General Technical Report RM-65, p 115-120, 1979. 17 Ref.

Descriptors: *Estuaries, *Pollution abatement, *Environmental effects, *Resources development, Powerplants, Oil, Gases, Fisheries, Habitat improvement, *Outer Continental Shelf, Gulf of Mexico.

The commercial and sport fisheries of the Gulf of Mexico are heavily dependent on the estuaries of the northern Gulf coast. A large variety of man-induced modifications in these estuaries are threatening these resources and the quality of the supporting habitat. This report summarizes potential impacts on the habitat and resource for each type of modification and lists mitigative measures which may be taken to offset these impacts. (Sinha-OEIS)
W80-04191

MITIGATING OIL SPILL DAMAGE--ECOLOGICALLY RESPONSIBLE CLEAN-UP TECHNIQUES,
Chemical Manufacturers Association, Washington, DC.
G. V. Cox, and E. B. Cowell.
In: The Mitigation Symposium: a National Workshop on Mitigating Losses of Fish and Wildlife Habitats, held Fort Collins, CO on July 16-20, 1979. Forest Service General Technical Report RM-65, p 121-128, 1979. 43 Ref.

Descriptors: *Oil spills, *Pollution abatement, *Safety factors, *Oil pollution, Ecology, Water pollution, Environmental effects, Resources development, *Outer Continental Shelf.

Effective mitigation requires preplanning experience, ecological input to planning and the event, and a thorough understanding of political and social demands in oil spill clean-up programs. Attention to public safety should receive primary attention before the ecological and social considerations. The clean-up techniques and their results are analyzed. (Sinha-OEIS)
W80-04192

COASTAL IMPACT MITIGATION AND OCS-INDUCED OIL AND GAS DEVELOPMENT: A PERSPECTIVE OF THE CLEAN WATER ACT'S SECTION 404 GUIDELINES,
Environmental Protection Agency, Washington, DC. Office of Water Planning and Standards.
C. R. Terrell, and L. R. Shanks.
In: The Mitigation Symposium: a National Workshop on Mitigating Losses of Fish and Wildlife Habitats, held Fort Collins, CO on July 16-20, 1979. Forest Service General Technical Report RM-65, p 270-275, 1979. 3 Ref.

Descriptors: *Resources development, *Oil pollution, *Ecosystems, *Environmental effects, *Pollution abatement, Water pollution effects, Ecosystems, Coasts, Dredging, Spoil banks, *Outer Continental Shelf, Petroleum industry.

In recent years the petroleum industry has increased its development effort of oil and gas resources on the nation's Outer Continental Shelf (OCS), while concomitantly there has been a rapid increase in coastal development by the petroleum industry and others. Environments and ecosystems have sustained large alterations, leading to reduced productivity and loss of prime fish and wildlife habitat. The Clean Water Act of 1977 Guidelines mandate the examination of practical alternatives to the discharge of dredged or fill material. A general evaluation determines the possibility of a chemically polluted sediment. 'Guidelines to Minimize Impacts' are incorporated concerning the substrate, water quality, tidal fluctuations, currents, salinity and other characteristics. Particular attention must be given to minimize construction impacts to special aquatic sites, such as sanctuaries, refuges, wetlands, vegetated shallows and coral reefs. Based on the Factual Determinations which are made, the Corps of Engineers must decide if the proposed action is in compliance with the S404 Guidelines, and thus whether or not to issue the permit. (Sinha-OEIS)
W80-04193

PRE-IMPACT PROCESS ANALYSIS: DESIGN FOR MITIGATION,
LGL Ecological Research Associates, Grand Junction, CO.
J. C. Truett.
In: The Mitigation Symposium: a National Workshop on Mitigating Losses of Fish and Wildlife Habitats, held Fort Collins, CO on July 16-20, 1979. Forest Service General Technical Report RM-65, p 355-360, 1979. 9 Ref.

Descriptors: *Resources development, *Pollution abatement, *Water pollution effects, *Environmental effects, Oil pollution, Habitats, Ecology, Baseline studies, Alaska, *Outer Continental Shelf, Petroleum development, Environmental impact, Process analysis, Beaufort Sea.

A study of physical and biological processes supporting important fish and wildlife species along Alaska's Beaufort Sea coast suggests how petroleum development can proceed with the least possible impact. The study's strategy--process analyses-- is generic in nature and is broadly applicable for identifying mitigative measures to accompany many kinds of development. This strategy is preferable to a more traditional inventory-based environmental assessment. (Sinha-OEIS)
W80-04194

THE FISHERY CONSERVATION AND MANAGEMENT ACT AS A TOOL FOR MITIGATION IN OUTER CONTINENTAL SHELF PETROLEUM DEVELOPMENT,
Woods Hole Oceanographic Institution, MA. Marine Policy and Ocean Management Program.
A. Rieser, and J. Spiller.
In: The Mitigation Symposium: a National Workshop on Mitigating Losses of Fish and Wildlife Habitats, held Fort Collins, CO on July 16-20, 1979. Forest Service General Technical Report RM-65, p 653-664, 1979. 3 Fig, 60 Ref.

Descriptors: *Resources development, *Environmental effects, *Water pollution effects, Oil pollution, Fisheries, Oil spills, *Outer Continental Shelf, Georges Bank, Petroleum development, Fishery Conservation and Management Act.

Georges Bank, on the Northwest Atlantic Continental Shelf, represents one of the world's most productive fisheries; yet, the adverse environmental effects associated with Outer Continental Shelf (OCS) petroleum development threaten this productivity. Current and proposed regulations applicable to OCS petroleum development inadequately protect critical fishery habitats on the Georges Bank. The Fishery Conservation and Management Act of 1976 (FCMA), through the regional Fishery Management Plans (FMP), provides a process for the definition and protection of these critical fishery habitats. On the Georges Bank, this operation involves the identification of spawning and prime grounds of species of concern and then the inclusion of these areas in the FMPs. Thus, by incorporating such critical areas into a FMP approved by the Secretary of Commerce, these areas would receive special consideration, so that the adverse effects of offshore development on fisheries would be minimized. (Sinha-OEIS)
W80-04195

THE MISSISSIPPI, ALABAMA, FLORIDA, OUTER CONTINENTAL SHELF BASELINE ENVIRONMENTAL SURVEY - MAFLA 1977/1978. VOLUME 1-B. EXECUTIVE SUMMARY REPORT.
Dames and Moore, Los Angeles, CA.
Available from the National Technical Information Service, Springfield, VA 22161 as PB-294 228, Price Codes: A03 in paper copy, A01 in microfiche. Final Report to Bureau of Land Management, January 1979. 30 p, 16 Fig. AA550-CT7-34.

Descriptors: *Baseline studies, *Environmental effects, *Resources development, Water quality,

Ecosystems, Monitoring, Surveys, *Outer Continental Shelf, Mississippi, Alabama, Florida.

The prime purpose of the MAFLA program was the determination of ongoing or potential impacts on the outer continental shelf (OCS) environment from oil and gas development. The Executive Summary Report is organized along the same lines as the Program Synthesis Report, with sections on methodology, geology, physical oceanography, chemistry and biology. A brief summary and lists of recommended monitoring parameters and major deficiencies in the data base are also included. No attempt has been made to support those lists in detail or uniformly within the text of this volume. However, the reader requiring such backup is referred to Volume I-A from which both lists were derived. (Sinha-OEIS)
W80-04196

OTEC PHYSICAL AND CLIMATIC ENVIRONMENTAL IMPACTS: AN OVERVIEW OF MODELING EFFORTS AND NEEDS,
Argonne National Lab., IL. Energy and Environmental Systems Div.
J. H. Allender, J. D. Ditmars, R. A. Paddock, and K. D. Saunders.
In: Proceedings of: Fifth Ocean Thermal Energy Conversion Conference, held Miami Beach, Florida, February 20-22, 1978, Conf - 780236 Lavi, A. (ed.), p III-165-III-185, September 1978. 2 Tab, 22 Ref.

Descriptors: *Energy conversion, *Thermal powerplants, *Models, *Baseline studies, Resources development, Environmental effects, Thermal pollution, Water pollution, *Outer Continental Shelf, Ocean Thermal Energy Conversion(OTEC).

The present overview of studies of the effects of ocean thermal energy conversion (OTEC) plant operation on the physical environment of the ocean includes a review of the pertinent results of past and contemporary model efforts in terms of their implications for OTEC development and suggestions for future research consistent with OTEC timetables. Particular consideration is given to the areas of utilization of the thermal resource, effects of a single OTEC plant, and aggregate effects of many OTEC plants. These potential effects include modification of the local temperature, salinity, and nutrient distributions, induced changes in mixed-layer depths and sea-surface temperatures, and dispersal of biocides or working fluids (due to leaks). Review of model capabilities and limitations suggests that physical model studies also are needed to meet near-term OTEC needs for predictions of the complex near-field (1-3 km) effects of a single OTEC plant. An estimate for the aggregate effect of many OTEC plants on the horizontal thermohaline structure of the ocean is made in terms of the power density that would be required to sustain an induced, mesoscale anomaly against natural dissipation (as measured in a Gulf Stream eddy). Careful synthesis of the results of several models, in a spatial hierarchy from near-field to basin-wide scales, is required to provide reliable estimates of physical environmental impacts for OTEC purposes. (Sinha-OEIS)
W80-04197

PROGRESS REPORT FOR THE ENVIRONMENTAL IMPACT ASSESSMENT PROGRAM FOR THE 1-MWE EARLY OCEAN TEST PLATFORM,
Interstate Electronics Corp., Anaheim, CA. Oceanic Engineering Div.
M. D. Sands.
In: Proceedings of: Fifth Ocean Thermal Energy Conversion Conference, held Miami Beach, Florida, February 20-22, 1978, Cont - 780236 Lavi, A (ed.), p III-186-III-202, September 1978. 4 Fig, 1 Tab, 12 Ref.

Descriptors: *Energy conversion, *Environmental effects, *Thermal powerplants, Thermal pollution, Biota, Resources development, Gulf of Mexico, Hawaii, Puerto Rico, *Outer Continental Shelf, Ocean Thermal Energy Conversion(OTEC), Environmental impact assessment, Early Ocean Testing Platform.

The 1-MWe Ocean Thermal Energy Conversion Early Ocean Testing Platform (EOTP) has a projected test date in mid-1979 in the Gulf of Mexico, Hawaii, or Puerto Rico. This presentation summarizes the progress to date for the environmental impact assessment program for OTEC-1, the Early Ocean Testing Platform. The considerations in assessing impact for OTEC-1 first require a detailed description of the physical system design. Included in the design description are the depth of intake and discharge pipes, volumes discharged, and applicable safety regulations and procedures. The detailed site descriptive information including the biological, chemical, physical oceanographic and meteorological data must be gathered from all available sources. Particular study areas include the effects of impingement and entrainment, biocide effectiveness and toxicity to nontarget biota, working fluid release effects, climatological impacts, and worker safety. Also, the International, Federal, State, and local legal implications of siting will be considered. While socioeconomic impacts of OTEC-1 now appear to be minimal, there is potential later for substantial benefits to the resident community services. When all relevant data is at hand the predictive process for assessing environmental impact is underway. (Sinha-OEIS)
W80-04198

5D. Waste Treatment Processes

FUNCTIONAL POLYMERS FOR REMOVAL OF HEAVY-METAL POLLUTANTS FROM WATER,
West Virginia Univ., Morgantown. Water Research Inst.
A. Winston, D. G. Kirchner, and J. W. Rosthauser.
Available from the National Technical Information Service, Springfield, VA 22161 as PB80-158215, Price codes: A03 in paper copy, A01 in microfiche. Information Report 13, 1980. 38 p, 9 Fig, 14 Tab, 49 Ref, 1 Append. OWRT A-031-WVA(1), 14-34-0001-8052.

Descriptors: *Acid mine water, *Cation exchange, *Chelation, *Demineralization, *Heavy metals, *Iron, *Polymers, *Water treatment, Effluents, Heavy metal binding polymers, Industrial wastes, Ion exchange, Mine drainage, Mine water, Waste water treatment, Water pollution, Water treatment.

The project was to design polymeric ion-exchange resins specific for metal ions and particularly for systems for removing iron from water. The resins are vinyl polymers bearing hydroxamic acids and have strong affinity for iron. Polymers were prepared in which the spacing of the hydroxamic acids were varied. The stability constants of the iron complexes showed that the spacing of the hydroxamic acids was important both in complex stability and in the selectivity of the resin for iron. The polymer having the largest binding constant for iron had an 11-atom spacing between hydroxamic-acid groups. This polymer, prepared in an insoluble form, removed to less than 0.5 ppm iron from water. The polymer could be regenerated by washing with sodium hydrosulfite or EDTA. Copolymers bearing hydroxamic acid groups crosslink in the presence of iron, resulting in viscosity increases and flocculation. Polymers for binding copper and mercury were synthesized and evaluated. The functional group for copper was the tripeptide glycylglycylhistidine. For mercury, polymers containing sulfide were studied. Preliminary evaluation showed that the polymers formed complexes with copper and mercury. Various applications of these resins in environment, health, and industry are suggested.
W80-03911

INVENTORY AND EVALUATION OF ELEVATED SAND MOUND SEWAGE DISPOSAL SYSTEMS IN PENNSYLVANIA,
Pennsylvania State Univ., University Park. Dept. of Agronomy.
M. T. Hoover.
Available from the National Technical Information Service, Springfield, VA 22161 as PB80-158207, Price codes: A05 in paper copy, A01 in microfiche. Master of Science Thesis, March 1979. 78 p, 5 Fig, 7 Tab, 50 Ref. OWRT B-098-PA(1), 14-31-001-7129.

Descriptors: *Sewage disposal, *Pennsylvania, Topsoil, Elevation, Berms, Construction, Soils, Design, Installation, Maintenance, Distribution, Water table, *Septic tanks, Effluent, *Waste water treatment, *Elevated sand mound system, Problem soils, Sandy fill, Malfunctions, Questionnaire, Sewage enforcement officer, Costs.

The elevated sand mound system, which is installed on the soil surface, has been used on problem soils in Pennsylvania since 1974. The purpose of this study was to ascertain the current state-of-the-art of elevated sand mound systems from an inventory of those systems in Pennsylvania, to determine how many were surface discharging, and to identify possible causes of these malfunctions. Questionnaires were sent to 705 sewage enforcement officers in Pennsylvania. Field trips were conducted to determine the rate and causes of surface discharge malfunctions. Most elevated sand mounds are located near densely populated areas and in areas where problem soils predominate. Questionnaire respondents indicated that over 5000 of these systems have been installed at an average cost of $2756. Forty-three percent of the systems in Pennsylvania are malfunctioning or have malfunctioned in the past, costing Pennsylvanians as much as six million dollars over a period of less than four years. The construction of berms was not found to prevent systems from surface discharging over slowly permeable soils. The presently used 10-cm diameter pipe is too large for adequate effluent distribution. Current regulations are inadequate to prevent surface discharge of the system. The design presently used is not flexible enough to accommodate the variety of soil conditions found in Pennsylvania.
W80-03912

RENOVATION OF SEPTIC TANK EFFLUENT IN SAND-CLAY MIXTURES,
Pennsylvania State Univ., University Park. Dept. of Agronomy.
B. P. Willman.
Available from the National Technical Information Service, Springfield, VA 22161 as PB80-158272, Price codes: A06 in paper copy, A01 in microfiche. Master of Science thesis, May 1979, 100 p, 12 Tab, 2 Fig, 31 Ref. OWRT B-098-PA(2), 14-31-0001-7129.

Descriptors: *Waste water disposal, Sands, Clays, Limestones, Shales, Coliforms, Chemical oxygen demand, Conductivity, Pathogenic bacteria, *Septic tanks, Ions, Materials, Particle size, *Effluents, Statistics, Sandstones, *Reclaimed water, *Rehabilation, *Waste water treatment, Sand mounds.

Research was conducted to determine if the clay material in a sandy fill significantly influences the renovation of septic tank effluent. Limestone, sandstone, and shale sands were used alone and combined with 3, 6, and 12 percent clay. Two natural sands also were used. Septic tank effluent was applied to the surface of 10-cm diameter plexiglass columns of all sands for 23 weeks. The effluent was analyzed at regular intervals for 16 chemical and biological variables before and after flowing through 60 cm of the sand. These variables were: pH, chemical oxygen demand, fecal coliforms, fecal streptococci, ammonium-nitrogen, total Kjeldahl nitrogen, nitrite-nitrogen, nitrate-nitrogen, nitrate-nitrite-nitrogen, orthophosphate, total phosphorus, chloride, calcium, sodium, potassium, and specific conductivity. All the sand-clay combinations removed over 99 percent of the fecal coliforms and streptococci. The removal of phosphorus and chemical oxygen demand, and the nitrogen transformations, were efficient in the limestone and shale sands regardless of clay content. The optimum pH for biological activity in the limestone sands rendered added renovating ability. The sandstone sand, a relatively inert material, was significantly influenced by clay content, particularly by the positive influence that the clay had on the pH. The results of the study indicate that limestone is the most desirable sand type, followed by sand-

stone with a small percentage of clay, and then by shale.
W80-03913

HYDRAULIC EVALUATION OF A MOUND SYSTEM IN MAINE,
Maine Univ. at Orono.
For primary bibliographic entry see Field 5B.
W80-03962

OPTIMIZED ECONOMIC USE OF SLUDGE TREATMENT FACILITIES IN DURBAN,
Durban City Engineer's Dept. (South Africa).
For primary bibliographic entry see Field 5B.
W80-03979

QUALITY AND TREATMENT OF WATER INVOLVED WITH COAL SLURRY TRANSPORT BY PIPELINE,
Missouri Univ.-Columbia. Dept. of Chemistry.
S. E. Manahan, J. A. Godwin, and M. H. Shinn.
Available from the National Technical Information Service, Springfield, VA 22161 as PB80-160724, Price codes: A03 in paper copy, A01 in microfiche. Missouri Water Resources Research Center, University of Missouri Completion Report, March 1980, 30 p, 14 Fig, 11 Ref. OWRT A-110-MO(2), 14-34-0001-9027.

Descriptors: *Coals, *Slurries, *Transportation, *Pipelines, Coal slurry pipelines, Heavy metals, Leaching, Humic acid, Water quality, Water treatment, Coal-water ratio, Water reuse, Lignite, Bituminous coal.

This document is a report of an investigation of the leaching of metals and organic matter from subbituminous coal and lignite under simulated coal slurry pipeline conditions. The leaching of metals present in the coals was investigated. These metals include iron, calcium, magnesium, aluminum, sodium, potassium, manganese, lead, copper, zinc, cobalt, nickel, chromium, and lithium. After leaching under slurry conditions for 24 hours, lead, cobalt, nickel, and chromium could not be detected in the water by flame atomic absorption. The percentages of the other metals extracted by water under slurry conditions ranged from 0.01 to 75%. The percentage of metal extracted varied widely with the type of metal and with the coal/water ratio in the slurry. Coal humic acids were extracted from coal in approximately 2% slurries and were readsorbed at coal percentages exceeding approximately 5%. These organic substances were shown to be involved in the solubilization of iron, copper, and aluminum.
W80-04108

EVALUATION OF MOUND SYSTEMS FOR PURIFICATION OF SEPTIC TANK EFFLUENT,
Wisconsin Univ.-Madison. Dept. of Soil Science.
C. J. Fitzgerald.
Available from the National Technical Information Service, Springfield, VA 22161 as PB80-158132, Price codes: A09 in paper copy, A01 in microfiche. M.S. Thesis, 1979. 310 p, 26 Fig, 18 Tab, 112 Ref. OWRT B-099-WIS(2), 14-34-0001-7200.

Descriptors: *Septic tanks, *Efficiencies, *Wisconsin, *Domestic wastes, *Sewage bacteria, Sewage disposal, Sewage treatment, Soil disposal fields, Water pollution source, Coliforms, Streptococcus, Pseudomonas, Viruses, Nutrient removal, Public health, Alternative septic systems, *Mound systems, Environmental sanitation, *Water purification.

Thirty-three mound systems for on-site disposal of septic tank effluent (STE) installed by commercial contractors in Wisconsin were surveyed and monitored for proper design, installation, operation, and wastewater purification. Every system examined was correctly sized and constructed but many systems were being dosed inappropriately with large volumes of STE. In these systems, bacteria and nutrients (N and P) from the STE penetrate deeper into the soil than in systems being properly dosed with more frequent smaller volumes of STE. However all systems removed bacteria, viruses and phosphorus effectively and reduced the N load passing through the soil by nitrification-denitrification. No evidence of contamination by bacteria, N or P could be found in high groundwater near 4 systems located over permeable soils. The pressure system used for STE distribution in Wisconsin mounds prevents the formation of biological crusts where the STE enters the soil, a phenomenon which leads to failure of conventional systems. Three cases of mound system failure reported in the state were due to faulty construction, not improper design or clogging. Wisconsin mound systems are expected to outlive and out perform conventional septic systems. (Harkin-Wis)
W80-04112

IMPACT OF WASTE DIVERSION ON WATER QUALITY IN LAKES,
Limno Tech, Inc., Ann Arbor, MI.
For primary bibliographic entry see Field 3C.
W80-04144

LEAST COST SOLUTIONS TO THE PROBLEM OF EFFLUENT ABATEMENT IN URBAN SYSTEMS,
Commerce and Business Administration, Vancouver (British Columbia).
P. N. Nemetz, and H. D. Drechsler.
Water Resources Bulletin, Vol 15, No 5, p 1374-1384, October 1979. 2 Fig, 5 Tab, 11 Ref.

Descriptors: *Systems analysis, *Municipal wastes, *Treatment facilities, *Cost analysis, *Optimization, *Pollution abatement, Economics, Sewage, Costs, Effluents, Marginal costs, Biochemical oxygen demand, Mathematical models, Sewage disposal, Sewage treatment, Alternative planning, Institutional constraints, Political aspects, Urban runoff, Treatment, Cost sharing.

A methodology identifies least-cost treatment systems for waterborne effluents generated within municipalities; the optimal solution entails an appropriate treatment distribution among all dischargers rather than sole reliance on centralized municipal treatment. Currently resources are misallocated because solutions are adopted without adequate evaluation of alternative treatment technologies, distributions of responsibilities for waste treatment and mechanisms for inducing compliance. One of the principal reasons for limited alternative search is the perverse incentives in the current institutional structure. The analysis is conducted in four steps: (1) construction of a systems materials balance; (2) assessment of estimated operating and capital costs of alternative sewage treatment levels; (3) identification of the optimal treatment solution; and (4) delineation and examination of several alternative implementation schemes. A hypothetical municipality with a population of 10,000 people is used. The source and deposition of biochemical oxygen demand is the principal focus; marginal cost curves are derived for different alternatives. Several implementation schemes mechanisms are available to local and regional governments once the optimal treatment solution is identified. Economic incentives could be employed to induce each a major polluter to treat wastes to the level desirable from a system-wide perspective. (Danovich-Wisconsin)
W80-04154

BENEFIT ANALYSIS FOR COMBINED SEWER OVERFLOW CONTROL.
EPA Technology Transfer Seminar Publication, EPA-625/4-79-013, April 1979. 54 p, 19 Fig, 8 Tab, 20 Ref.

Descriptors: *Cost-benefit analysis, *Combined sewers, *Combined sewer overflows, *Control, *Mathematical models, *Water pollution control, *Water quality control, Sewers, Overflow, Overflow control, Pollution sources, Stormwater models, Stormwater discharge, Stormwater, Technology, Sewage system, Collection system, Legislation.

Combined sewers are collection systems that combine both sanitary sewage and stormwater. They are typically found in older cities. Combined sewer overflows occur during or after storm events and their volumes and frequency are related to the rainfall patterns; they occur at discrete overflow points; and they contain the constituents found both in urban stormwater and in sanitary sewage. The result of an overflow can be significant discharge of organic material, nutrients, sediment, microorganisms, oil and grease, and metals and other potentially toxic substances into the receiving water. Benefit analysis is concerned with identifying the effects of overflows and the anticipated results of effecting change in them. There are two types of mathematical models useful in combined sewer overflow control planning--stormwater models and receiving water quality models. Stormwater models are tools to estimate or predict the volume of stormwater discharge and the loadings of its constituent pollutants. Receiving water quality models predict or simulate the effects of pollutant sources on the quality of the body of water into which they are discharged. Technologies to control pollution from combined sewer overflow can be grouped into three main categories: source controls to reduce the amount of pollutants entering the sewer system, collection system control to improve the system's effectiveness in storing and handling the flows, and off-line storage and treatment to remove pollutants from combined sewer flows. (Iervolino-NC)
W80-04165

LAND TREATMENT OF MUNICIPAL WASTEWATER EFFLUENTS: DESIGN FACTORS-I.
EPA Technology Transfer Seminar Publication, January 1976. 49 p, 3 Fig, 13 Tab, 37 Ref.

Descriptors: *Municipal wastes, *Waste disposal, *Waste water treatment, *Irrigation, *Land treatment, *Land application, *Design criteria, Wastes, Wastewater, Disposal, Sewage, Infiltration-percolation, Overland flow, Effluents, Sewage treatment, Sewage effluents, Land use, Design data.

Land application of wastewater or treated effluent involves the use of plants, the soil surface and the soil matrix for removal of certain wastewater constituents. The three basic methods of land application are irrigation, infiltration-percolation, and overland flow--irrigation being the predominant method in use today. Prior to land application, treatment of wastewater may be necessary in order to maintain a reliable distribution system, avoid nuisance conditions, maintain high infiltration rates, and so that the irrigated crops can be used for human consumption. The suitability of the land is judged by its location to the wastewater collection/treatment facilities; compatibility of planned objectives with overall land use plan; proximity to surface waters; and number and size of available land parcels. Other characteristics that should be considered are climate, topography, vegetation and geology and soils. For irrigation, land treatment distribution techniques can be classified into three main groups: fixed sprinkling systems, moving sprinkling systems and surface application systems. Comprehensive monitoring programs are required to ensure that proper renovation of wastewater is occurring and that environmental degradation is not occurring. (See also W80-04167) (Iervolino-NC)
W80-04166

LAND TREATMENT OF MUNICIPAL WASTEWATER EFFLUENTS: DESIGN FACTORS-II.
EPA Technology Transfer Seminar Publication, January 1976. 72 p, 22 Fig, 10 Tab, 42 Ref.

Descriptors: *Municipal wastes, *Waste disposal, *Waste water treatment, *Irrigation, *Land treatment, *Land application, *Design criteria, Wastes, Wastewater, Disposal, Sewage, High-rate irrigation, Overland flow, Infiltration-percolation, Effluents, Sewage treatment, Sewage effluents, Land use, Design data.

Land treatment or land application is the treatment of wastewater by using plant cover, soil surface, soil profile and geologic materials to remove cer-

tain wastewater pollutants. The main concern about this method is the possible harmful effects of the pollutants on the vegetation, soil and surface and groundwaters. Four possible processes successfully used are overland flow, irrigation, high-rate irrigation, and infiltration-percolation. Factors affecting site selection include soil, geology and groundwater, land use, sensitive environmental areas, water rights, the land application process, topography, and political boundaries and land ownership. For each process the effluent loading rate may be limited by the following constraints: infiltration capacity, soil permeability, soil and plant capacity to remove nitrogen and phosphorous, soil capacity to filter and assimilate suspended solids, soil capacity to remove and oxidize BOD and COD, soil capacity to remove and assimilate inorganic chemicals, discharge requirements to groundwater and surface water, and climatic influences such as precipitation, evapotranspiration and growing season. Components of land application systems include transport, preapplication treatment, storage, distribution, irrigation, surface drainage, subsurface drainage, buffer area and monitoring system. (See also W80-04166) (Iervolino-NC)
W80-04167

LAND TREATMENT OF MUNICIPAL WASTEWATER EFFLUENTS: CASE HISTORIES.
EPA Technology Transfer Seminar Publication, EPA-625/4-76-010, January 1976. 79 p, 13 Fig, 29 Tab, 36 Ref.

Descriptors: *Municipal wastes, *Waste disposal, *Waste water treatment, *Land treatment, *Sewage treatment, *Effluents, Wastes, Disposal, Treatment facilities, Irrigation, Infiltration, Wastewater reclamation.

In recent years, a number of experimental/operational systems have been designed to renovate wastewater by land application. This publication presents case histories of five properly managed systems of land application of municipal wastewater. The five facilities considered are: (1) the Michigan State University Water Quality Management Project (WQMP); (2) the City of Tallahassee Spray Irrigation Project (TSIP); (3) the Flushing Meadows Project (FMP); (4) the Pennsylvania State University Wastewater Renovation and Conservation Project (WRCP); and (5) the City of Boulder (CO) Project (BCP). Three of these were designed initially as pilot plants to provide alternative methods of wastewater removal from currently operating plants. The Michigan State University WQMP was designed exclusively as a research and development project to study alternative aquatic and terrestrial applications of wastewater to utilize the components as food for plants and animals. At Boulder, Colorado, the impetus for the BCP was that land treatment showed an economic advantage. Two of the programs--WQMP and WRCP--have seasonable variables that affect their operation, whereas year-round operation is possible at TSIP and FMP. The Flushing Meadows project pumps the water into infiltration basins from which it is rapidly absorbed into the soil instead of a spray irrigation system which the City of Tallahassee uses. The Pennsylvania State University WRCP was initiated to evaluate alternative methods of preventing further eutrophication of a stream that received effluent from a sewage treatment plant. (Iervolino-NC)
W80-04168

STATUS OF OXYGEN-ACTIVATED SLUDGE WASTEWATER TREATMENT.
EPA Technology Transfer Seminar Publication, EPA 625 4-77-003a, October 1977. 46 p, 17 Fig, 20 Tab, 6 Ref.

Descriptors: *Waste water treatment, *Oxygen-activated sludge treatment, *Water pollution treatment, *Sludge treatment, *Second Generation Open Reactor Oxygen System(MAROX), *Sewage effluents, Treatment, Sewage treatment, Waste water disposal, Water treatment, Wastes, Effluents.

The use of oxygen gas in the activated sludge process has evolved in the last eight years from a level of primarily academic interest to a point of broad application and implementation especially in North America and Japan. By 1980 it is projected that 150 oxygen systems will be in operation; as of June 1976 50 plants were in operation. Oxygen dissolution concepts include both covered and open reactor alternatives. Included in this study is a description of the second generation open reactor oxygen system (MAROX) for which there are two versions: one utilizing rotating active diffusers (RADs), the other fixed active diffusers (FADs). Presently the second generation RAD design appears to be a significant cost-effective improvement compared to the original FAD design. Evaluation of the MAROX system was done by the Metropolitan Denver (CO) Sewage Disposal District No. 1 funded by the U.S. Environmental Protection Agency. This document also summarizes the operating and performance data for 11 oxygen-activated sludge plants. Eight of the selected plants treat municipal wastewater and three are strictly industrial applications. The reactor designs for these plants represent a variety of configurations including both rectangular-stage systems and systems incorporating circular and acurate stages within larger self-contained circular tanks. (Iervolino-NC)
W80-04170

THE CODORUS CREEK WASTEWATER MANAGEMENT STUDY--ANALYSIS OF CONCLUSIONS: SUMMARY OF FINDINGS AND RECOMMENDATIONS.
Army Engineer District, Baltimore, MD.
For primary bibliographic entry see Field 5G.
W80-04171

THE CODORUS CREEK WASTEWATER MANAGEMENT STUDY--APPENDIX A. TECHNICAL STUDIES. VOL. I.
Army Engineer District, Baltimore, MD.
For primary bibliographic entry see Field 5G.
W80-04173

THE CODORUS CREEK WASTEWATER MANAGEMENT STUDY--APPENDIX A. TECHNICAL STUDIES. VOL. II.
Army Engineer District, Baltimore, MD.
For primary bibliographic entry see Field 5G.
W80-04174

THE CODORUS CREEK WASTEWATER MANAGEMENT STUDY--APPENDIX A. TECHNICAL STUDIES. VOL. III.
Army Engineer District, Baltimore, MD.
For primary bibliographic entry see Field 5G.
W80-04175

THE CODORUS CREEK WASTEWATER MANAGEMENT STUDY--APPENDIX A. TECHNICAL STUDIES. VOL. IV.
Army Engineer District, Baltimore, MD.
For primary bibliographic entry see Field 5G.
W80-04176

THE CODORUS CREEK WASTEWATER MANAGEMENT STUDY. APPENDIX B. IMPACT STUDIES.
Army Engineer District, Baltimore, MD.
For primary bibliographic entry see Field 5G.
W80-04177

THE CODORUS CREEK WASTEWATER MANAGEMENT STUDY. APPENDIX C. ANALYSIS OF INSTITUTIONAL ARRANGEMENTS.
Army Engineer District, Baltimore, MD.
For primary bibliographic entry see Field 5G.
W80-04178

UTILIZATION OF NATURAL ECOSYSTEMS FOR WASTEWATER RENOVATION,
Michigan State Univ., East Lansing. Inst. of Water Research.
T. M. Burton, D. L. King, R. C. Ball, and T. G. Bahr.
Available from the National Technical Information Service, Springfield, VA 22161 as PB80-100431, Price codes: A08 in paper copy, A01 in microfiche. Report EPA-905/3-79-003 prepared for Region V, Great Lakes National Program Office, U.S. Environmental Protection Agency, Chicago, April 1979. 155 p, 50 Fig, 6 Ref. 4005065.

Descriptors: *Water renovation, *Wastewater treatment, *Experimental facilities, *Municipal wastes, *Sewage treatment, *East Lansing(MI), *Ecosystems, Effluents, Sewage effluents, Waste water reclamation, Water reuse, Transmission lines, Phosphorus, Lakes, Biomass, Nitrogen, Forage crops, Land treatment, Irrigation.

This study describes the uses for a permanent facility constructed in the vicinity of the City of East Lansing, MI for the experimental recycling, treatment, and reuse of municipal sewage effluent on a 500 acre site on the campus of Michigan State University. The facility provides for diversion of up to 7570 cubic m/day of secondary effluent from the East Lansing activated sludge treatment plant. This waste flow is directed away from the receiving stream to an intensely managed aquatic and terrestrial nutrient recycling system. The facility consists of a portion of the wastewater treatment plant, a transmission line, a lake system of four experimental lakes, and a spray irrigation system. The four lakes used were found to significantly decrease effluent phosphorus load, nitrogen, alkalinity, and coliform bacteria. Forage crops were highly efficient in the uptake of nitrogen and phosphorus from wastewater and have the potential of renovating up to 7.5 cm/week of wastewater. Recommendations included spraying all water effluent on irrigated land and discharging none into the lakes, establishment of better biomass baseline data, managing the lakes so that nitrogen is stripped from incoming wastewater, and avoiding spraying high nitrogen wastewater in older forests since removal efficiency is low. Continued research needs are set out. (Arnold-NC)
W80-04188

5E. Ultimate Disposal Of Wastes

SOIL SUITABILITY FOR ON-SITE WASTE DISPOSAL: DEVELOPMENT OF GENETICALLY MARKED ESCHERICHIA COLI STRAINS AS TRACERS OF SUBSURFACE WATER FLOW,
Oregon State Univ., Corvallis. Water Resources Research Inst.
C. Hagedorn, and E. L. McCoy.
Available from the National Technical Information Service, Springfield, VA 22161 as PB80-160369, Price codes: A05 in paper copy, A01 in microfiche. Completion Report WRRI-65, November 1979. 81 p, 12 Fig, 6 Tab, 132 Ref. OWRT A-039-ORE(2).

Descriptors: *Subsurface flow, *Waste disposal, *Tracers, *Soil properties, Permeability, *Septic tanks, Effluents, *Path of pollutants, Bacteria, Saturated soils, Oregon, *Escherichia coli, Willamette Valley area(Oregon).

This study was undertaken to determine whether or not public health hazards could be created when septic-tank drainfield trenches became submerged under seasonal perched water tables on hillslope soils adjacent to the Willamette Valley, Oregon. The research results indicated that such hazards can occur when fecal bacteria are displaced under saturated flow conditions and transported downslope with resulting water contamination. The major research findings include: (1) Fecal organisms were transported, via saturated subsurface flow, for longer distances and over shorter periods of time than was expected or previously reported, (2) Antibiotic-resistant strains of Escherichia coli were found to be suitable as tracers of subsurface water flow through saturated soil profiles in western Oregon, (3) Fitting the data to dispersion equations indicated that dilution and dispersion were the major parameters controlling bacterial translocation under saturated conditions. Adsorption and filtration were minor considerations as long as soil

saturation was maintained, (4) Different organisms (bacteria and viruses) were transported through the saturated soils at rates equivalent to the speed of water flow. At this level the size of the particles which were transported was not a factor in the dynamics of subsurface translocation.
W80-04017

5F. Water Treatment and Quality Alteration

DEMINERALIZATION OF BRACKISH MUNICIPAL WATER SUPPLIES--COMPARATIVE COSTS,
Miller and Associates, Boulder, CO.
For primary bibliographic entry see Field 6B.
W80-03978

IMMUNE RESPONSE TO BACTERIAL IMMUNIZATION OF CHANNEL CATFISH MAINTAINED IN A RECIRCULATING WATER-REUSE SYSTEM,
Memphis State Univ., TN.
For primary bibliographic entry see Field 5C.
W80-04016

SELECTION AND USE OF POLYMERS IN CONTACT FILTRATION,
Missouri Univ.-Columbia. Dept. of Civil Engineering.
M. M. Ghosh, and H. H. Yeh.
Available from the National Technical Information Service, Springfield, VA 22161 as PB80-160351, Price codes: A07 in paper copy, A01 in microfiche. Missouri Water Resources Research Center, University of Missouri, Completion Report, February 1980. 134 p, 53 Fig, 11 Tab, 41 Ref. OWRT A-107-MO(1), 14-34-0001-8027 and 9027.

Descriptors: *Water treatment, *Filtration, *Polymers, Dosage selection, Cation exchange, Velocity gradient, Head loss, Floc breakup, High shear, *Turbidity removal, *Polyelectrolytes.

Laboratory investigations were carried out to determine the type and dosages of polymers best suited for direct filtration. Viscosity and conductivity measurements were found to be unreliable methods for determining dosages. Low to medium weight cationic polymers (M.W.= 1 x 10 to the fourth power to 1 x 10 to the fifth power) were found to be ideally suited for the direct filtration of low turbidity waters. The principal mode of interaction was adsorption and charge neutralization for these polymers. The best method of determining dosage was the jar test, using rapid mixing only at high liquid shear, followed by particle size analysis. For high molecular weight polymers bridging appears to be the primary mechanism of polymer action. Standard jar tests do not provide the high G's necessary to obtain the optimum mixing of polymers. Specifically, a maximum G of 300 sec-1 was required during rapid mixing of polymers with molecular weight in the neighborhood of 5x10 to the fourth power. The duration of mixing may vary from 3 to 8 minutes depending on the molecular weight, with large molecular weight polymers requiring less time, presumably because of fast adsorption and bridging. The ccc and the optimum dosages for flocculation were exponentially correlated with the charge density per molecule of the polymer. In filtration, flocs captured within the pores are liable to be subjected to high shear as the bed becomes clogged. This may cause breakup and dislodgement of predeposited flocs, which ultimately would breakthrough, much the same way desorption of solutes occur. For optimum filtering conditions, breakup occurred when G in the clogged bed exceeded 700 sec-1. The particle size distribution data clearly demonstrated the in situ flocculation within the filter bed, followed by breakage when G became large due to clogging.
W80-04018

POSSIBLE RELATION BETWEEN PHYTOPLANKTON NUMBERS AND SAPROLEGNIOID FUNGI IN SHATT AL-ARAB NEAR BASRAH, IRAQ,
Basrah Univ., Al Basrah (Iraq). Dept. of Biology.
H. A. Al-Saadi, S. S. Rattan, T. W. Muhsin, and H. A. Hameed.
Hydrobiologia, Vol 63, No 1, p 57-62, March 1979. 3 Fig, 1 Tab, 18 Ref.

Descriptors: *Iraq, *Shatt Al-Arab River(Iraq), *Fungi, *Phytoplankton, *Correlation analysis, Seasonal, Hydrogen ion concentration, Dissolved oxygen, Salinity, Biological communities, Growth rates, Diatoms, Speciation, Benthic flora, Algae, Population, Decomposing organic matter, Biodegradation, Water temperature.

Phytoplankton numbers correlate negatively with decomposing fungi, Saprolegniaceae, in Shatt Al-Arab River near Basrah, Iraq as measured September 1976-August 1977. During peak phytoplankton growth periods, fungi occurrence is minimal and during minimum phytoplankton growth periods, fungi are abundant. This relationship is significant throughout the year except in July-August when both phytoplankton and fungi numbers decrease due to unfavorable high temperatures. Fungi depend on phytoplankton as substrate which becomes available after phytoplankton decline and decay. Saprolegnioid fungi seasonal variation is independent of pH, salinity and dissolved oxygen. pH range fluctuates 7.0-8.0, salinity 0.74-1.04 ppt. Dissolved oxygen is usually saturated although it varies with temperature. However, fungi abundance significantly correlates with temperature. Phytoplankton maxima occur in October-November, March and June. Populations are dominated by benthic forms and dominant species are diatoms especially pinnate diatoms (74.76%). Green and blue-green algae are only 10.28% and 14.01%, respectively. Cyclotella meneghiniana dominates. Fungi maxima occur in January, April and September. Of 10 species, four belong to Saprolegnia, five to Achlya and one to Dictyuchus. (Danovich-Wisconsin)
W80-04119

PHOSPHATASE ACTIVITY AND ITS ROLE IN THE MINERALIZATION OF ORGANIC PHOSPHORUS IN COASTAL SEA WATER,
Tokyo Univ. (Japan). Ocean Research Inst.
H. Kobori, and N. Taga.
Journal of Experimental Marine Biology and Ecology, Vol 36, No 1, p 23-39, January 1979. 8 Fig, 3 Tab, 30 Ref.

Descriptors: *Cycling nutrients, *Phosphorus, *Bays, *Japan, *Bacteria, *Enzymes, Decomposing organic matter, Coasts, Biomass, Heterotrophy, Phytoplankton, Organic compounds, Biodegradation, Inorganic compounds, Degradation(Decomposition), Water chemistry, Biochemistry, Sea water, Primary productivity, Marine bacteria, Tokyo Bay(Japan), Sagami Bay(Japan), Suruga Bay(Japan).

Investigations of the role of phosphatase in mineralizing natural organic phosphorus in eutrophic Tokyo Bay and less eutrophic Sagami and Suruga Bays, Japan coastal waters, July 1973 and August 1977, demonstrate that phosphatase enzymes play a significant role in phosphorus regeneration in Tokyo Bay and especially in Sagami Bay. Alkaline phosphatase in Tokyo Bay is associated with bacterial biomass and closely parallels heterotrophic bacteria counts. Phosphatase activity also correlates with chlorophyll-a concentrations; therefore, bacteria and phytoplankton make major contributions to phosphatase production in Tokyo Bay. Organic phosphorus accounts for 48% of total phosphorus in Tokyo Bay (0-20 m) and 87% and 98% in surface waters (0-20 m) in Sagami and Suruga Bays, respectively. Phosphatase-hydrolysable organic phosphorus makes up 19% of organic phosphorus in the Tokyo Bay water column and 50% in Sagami Bay euphotic zone. In euphotic zones, phosphatase-hydrolysable organic phosphorus decomposes completely, suggesting that this organic fraction is recycled by primary production. Inorganic phosphorus released by phosphatase action makes up less than 10% of inorganic phosphorus present in Tokyo Bay and 67% in Sagami Bay. Therefore, phosphatase-hydrolysable organic phosphorus plays an important role as an inorganic phosphorus source in Sagami Bay. (Danovich-Wisconsin)
W80-04141

CAPITAL COST FUNCTIONS OF A SURFACE WATER TREATMENT PLANT AND ITS COMPONENTS,
Illinois Univ. at Urbana-Champaign. Coll. of Commerce and Business Administration.
For primary bibliographic entry see Field 6C.
W80-04161

THE CODORUS CREEK WASTEWATER MANAGEMENT STUDY--ANALYSIS OF CONCLUSIONS: SUMMARY OF FINDINGS AND RECOMMENDATIONS.
Army Engineer District, Baltimore, MD.
For primary bibliographic entry see Field 5G.
W80-04171

THE CODORUS CREEK WASTEWATER MANAGEMENT STUDY--APPENDIX A. TECHNICAL STUDIES. VOL. I.
Army Engineer District, Baltimore, MD.
For primary bibliographic entry see Field 5G.
W80-04173

THE CODORUS CREEK WASTEWATER MANAGEMENT STUDY--APPENDIX A. TECHNICAL STUDIES. VOL. II.
Army Engineer District, Baltimore, MD.
For primary bibliographic entry see Field 5G.
W80-04174

THE CODORUS CREEK WASTEWATER MANAGEMENT STUDY--APPENDIX A. TECHNICAL STUDIES. VOL. III.
Army Engineer District, Baltimore, MD.
For primary bibliographic entry see Field 5G.
W80-04175

THE CODORUS CREEK WASTEWATER MANAGEMENT STUDY--APPENDIX A. TECHNICAL STUDIES. VOL. IV.
Army Engineer District, Baltimore, MD.
For primary bibliographic entry see Field 5G.
W80-04176

THE CODORUS CREEK WASTEWATER MANAGEMENT STUDY. APPENDIX B. IMPACT STUDIES.
Army Engineer District, Baltimore, MD.
For primary bibliographic entry see Field 5G.
W80-04177

THE CODORUS CREEK WASTEWATER MANAGEMENT STUDY. SUPPLEMENT TO APPENDIX C. IMPLEMENTING A LAND-BASED SYSTEM--AN ANALYSIS OF APPROACHES.
Army Engineer District, Baltimore, MD.
For primary bibliographic entry see Field 5G.
W80-04179

5G. Water Quality Control

INCORPORATION OF PERCEPTUAL STANDARDS INTO A WATER QUALITY INFORMATION SYSTEM,
Auburn Univ., AL. Dept. of Accounting and Finance.
For primary bibliographic entry see Field 6A.
W80-03966

MULTIOBJECTIVE OPTIMIZATION IN WATER QUALITY AND LAND MANAGEMENT,
Virginia Univ., Charlottesville. Dept. of Environmental Sciences.
For primary bibliographic entry see Field 5B.
W80-04027

POST-WAR LAND DRAINAGE, FERTILIZER USE AND ENVIRONMENTAL IMPACT IN NORTHERN IRELAND,

New Univ. of Ulster, Coleraine (Northern Ireland). School of Biological and Environmental Studies.
For primary bibliographic entry see Field 4A.
W80-04115

KEEP RECREATIONAL WATERS ALGAE-FREE,
CH2M/Hill, Inc., Denver, CO.
J. J. Ahern, and B. L. Weand.
Water and Wastes Engineering, Vol 16, No 10, p 14-18, October 1979. 3 Fig.

Descriptors: *Detention reservoirs, *Flaming Gorge Reservoir(UT), *Recreation, *Aquatic weed control, *Eutrophication, Impoundments, Water pollution control, Water pollution sources, Water pollution effects, Nonpoint source pollution, Point source pollution, Phosphorus, Water skiing, Water sports, Erosion, Utah, Fishing, Swimming, Reservoirs.

Flaming Gorge was created in 1962 by damming the flow of the Green River in northeastern Utah. The reservoir watershed covers approximately 10,000 sq miles, and was built for two purposes: (1) Storage of water for irrigation, power generation, and municipal and industrial water supplies; (2) Water-based recreational opportunities such as swimming, fishing, boating. Eutrophication has been accelerated in Flaming Gorge Reservoir through human interference, and has produced negative effects on recreational opportunities. Algal mats, a side product of eutrophication, have been interfering with boating and swimming. The trout population decreased from 84% of the total fish population in 1964 to 9% in 1969, while non-game fish populations have correspondingly increased. The main cause of the accelerated eutrophication is high phosphorus levels. The phosphorus contribution from point and nonpoint sources is estimated at 575 tons/year, with natural and man-made erosion contributing the highest phosphorus percentage (87%), followed by municipal wastewater discharges (11%), and urban and septic tank runoff (2%). To maintain phosphorus concentrations within permissible levels would require an 80% reduction in the present phosphorus loading. However, natural erosion, the main phosphorus contributing factor may not be controllable. (Harris-Wisconsin)
W80-04116

PLANNING FOR NONPOINT POLLUTION CONTROL IN NORTH CAROLINA,
Soil Conservation Service, Raleigh, NC.
For primary bibliographic entry see Field 5B.
W80-04130

IMPACT OF WASTE DIVERSION ON WATER QUALITY IN LAKES,
Limno Tech, Inc., Ann Arbor, MI.
For primary bibliographic entry see Field 3C.
W80-04144

GROWTH AND POPULATION STUDIES ON TILAPIA GALILAEA IN LAKE KINNERET,
Israel Oceanographic and Limnological Research Ltd., Haifa.
R. Landau.
Freshwater Biology, Vol 9, No 1, p 23-32, February 1979. 1 Fig, 6 Tab, 25 Ref.

Descriptors: *Algal control, *Eutrophication, *Population, *Fish populations, *Lake Kinneret(Israel), Tilapia galilaea, Peridinium cinctum, Aquatic productivity, Nuisance algae, Water quality control, Fish establishment, Fish harvest, Fish farming, Fish reproduction, Life cycles, Growth rates, Life history studies, *Israel.

This study assessing stock size of endemic cichlid fish Tilapia galilaea in Lake Kinneret, Israel is prompted by earlier suggestions that water quality in this otherwise-unpolluted lake be maintained by using the fish to control algal blooms. Because the fish feeds selectively on bloom organism, Peridinium cinctum, the fish is considered useful in controlling the algae if enough fish population are maintained through stocking. It is suggested that recruitment of stocked fish can be increased by introduction in December and by use of fingerlings which can grow to marketable size in less than two seasons. Between 1967-1977 catches of this commercially taken fish dropped from an annual average of 200 t to 70 t, then increased to their original level. Assuming a natural mortality of 0.94, total stock size averaged 300-700 t during 1970-1976, while recruitment averaged 0.7-3 million/yr. Three broods hatched during relatively high water levels 1970-1972 yielded especially low recruitment. The Von Bertalanffy growth coefficient is estimated at 0.67 and final length at 25-36 cm. First year growth, 23-152 cm, is closely related to final length which in turn is affected by genetic variations in the total population. Changes in proportions of fast-growing and slow-growing fish cause yearly fluctuations in size distribution. Recruitment to the fishery, at 17-20 cm, occurs between 1+ and 3+ years of age. Highest growth rates for year-old fish, 1-2% mean wt/day, occurs April-May, the Peridinium season. During July only a small proportion of year-old fish reach marketable size, because of a diminishing food supply. (Harris-Wisconsin)
W80-04152

A CHANCE-CONSTRAINED GOAL PROGRAMMING MODEL TO EVALUATE RESPONSE RESOURCES FOR MARINE POLLUTION DISASTERS,
Texas Univ. at Austin. Center for Cybernetic Studies.
For primary bibliographic entry see Field 6A.
W80-04164

BENEFIT ANALYSIS FOR COMBINED SEWER OVERFLOW CONTROL.
For primary bibliographic entry see Field 5D.
W80-04165

LAND TREATMENT OF MUNICIPAL WASTEWATER EFFLUENTS: DESIGN FACTORS-I.
For primary bibliographic entry see Field 5D.
W80-04166

THE CODORUS CREEK WASTEWATER MANAGEMENT STUDY--ANALYSIS OF CONCLUSIONS: SUMMARY OF FINDINGS AND RECOMMENDATIONS.
Army Engineer District, Baltimore, MD.
Available from the National Technical Information Service, Springfield, VA 22161 as AD-A036 851, Price codes: A03 in paper copy, A01 in microfiche. April 1973. 30 p, 5 Fig, 26 Tab.

Descriptors: *Water resources planning, *Waste water treatment, *Water management(Applied), *Water pollution control, *Economic analysis, *Codorus Creek(PA), *Water quality, Economics, Social aspects, Water pollution, Water use, Comprehensive planning, Pennsylvania, Primary treatment, Secondary treatment, Tertiary treatment, Alternative planning, Water reuse.

This is a summary of the findings and recommendations of the District Engineer for the wastewater management system study for the Codorus Creek Basin, a 280 square mile portion of the Susquehanna River Basin in Southeastern Pennsylvania. The Codorus stream system is severely degraded. The District Engineer's specific recommendations include adoption of one of three of the six alternative plans--the December Plan, the Basic All Land Plan, or the Basic All Water Plan; establishment of a county wastewater management authority to carry out detailed planning for and supervision of implementation of the selected plan, and to pursue industrial reuse of wastewater effluents; development of a stormwater management plan; and immediate implementation of the selected plan. The report outlines the problems, study objectives and methodology. The six alternative plans are described: the Plan to Meet Current Standards, the December Plan, the Basic and Modified All Water Plans, and the Basic and Modified All Land Plans. A reuse option would be applicable to any of these plans. The Summary of Findings includes proposals for ways for these plans to meet requirements of the Federal Water Pollution Control Act Amendments, P.L. 92-500, as well as a discussion of environmental, social, and economic impacts of each alternative plan. The effects of each of the alternative plans are organized in terms of 'premise sets' to facilitate choice among the plans, focusing on four of the plans. (Arnold-NC)
W80-04171

THE CODORUS CREEK WASTEWATER MANAGEMENT STUDY--APPENDIX A. TECHNICAL STUDIES. VOL. I.
Army Engineer District, Baltimore, MD.
Available from the National Technical Information Service, Springfield, VA 22161 as AD-A036 853, Price codes: A04 in paper copy, A01 in microfiche. August 1972. 70 p, 27 Exhibits.

Descriptors: *Water resources planning, *Waste water treatment, *Water management(Applied), *Water pollution control, *Economic analysis, *Codorus Creek(PA), *Water pollution, *Water supply, *Water quality control, *Water quality, Economics, Social aspects, Water use, Comprehensive planning, Pennsylvania.

The Codorus Creek Wastewater Management study was undertaken to recommend actions necessary to improve significantly the water quality of the creek in order to provide a basis for restoration of natural environmental values and enhancement of the economic and social needs of the people. The Codorus stream system, which is severely degraded, covers 280 square miles in southern Pennsylvania. This appendix defines the study area. Current demographic and economic conditions are outlined, including present population distribution and the levels of area economic activity. Geophysical resources discussed include the basin's geology, hydrogeology, soils, and hydrology. Surface water supply management systems and their development are examined, and present wastewater management systems are described including municipal, manufacturing-commercial, and private systems; irrigation with wastewater; waste loadings; stormwater and combined sewer effects; and management of sludge solids. Water quality conditions are discussed and analyzed. Physical, chemical and biological conditions are described and the principal water quality problems are identified. A summary of existing water quality conditions is included. (Arnold-NC)
W80-04173

THE CODORUS CREEK WASTEWATER MANAGEMENT STUDY--APPENDIX A. TECHNICAL STUDIES. VOL. II.
Army Engineer District, Baltimore, MD.
Available from the National Technical Information Service, Springfield, VA 22161 as AD-A036 854, Price codes: A03 in paper copy, A01 in microfiche. August 1972. 47 p, 19 Exhibits.

Descriptors: *Water resources planning, *Waste water treatment, *Water management, *Water pollution control, *Economic analysis, *Codorus Creek(PA), *Water quality control, *Water quality, Economics, Social aspects, Water use, Water demand, Comprehensive planning, Pennsylvania, Primary treatment, Secondary treatment, Tertiary treatment, Industry, Projections, Economics.

The Codorus Creek Wastewater Management study was undertaken to recommend actions necessary to improve significantly the water quality of the creek in order to provide a basis for restoration of natural environmental values and enhancement of the economic and social needs of the people. The Codorus stream system, which is severely degraded, covers 280 square miles in southern Pennsylvania. The purpose of this appendix is to identify and evaluate future water resource-wastewater management needs based on assessments of future area growth and environmental management objectives. Demographic and economic growth trends are presented for the area. Population forecasts are made through the year 2020; population is expected to double from 1970 to 2020. Wastewater flow projections are made for

domestic wastewater and manufacturing and commercial wastewater systems. These systems are expected to change in mix from 50%-50% in 1970 to 70% domestic-30% manufacturing-commercial by the year 2000. Future water supply demand on the area's system will depend upon the future mix of domestic and manufacturing-commercial uses as well as upon the availability of supplies for those uses. Water quality management objectives for the area are discussed. Water quality criteria for streams are presented. Existing management action includes a pollution abatement implementation plan. The long-range effects of the plan are summarized and water nutrient reduction relationships are discussed. Further removal of nitrogen and phosphorous is necessary to obtain water quality conditions satisfactory for multiple use objectives. Nitrogen reduction should be 90% or greater, and phosphorous reduction, 95-98%. (Arnold-NC)
W80-04174

THE CODORUS CREEK WASTEWATER MANAGEMENT STUDY--APPENDIX A. TECHNICAL STUDIES, VOL. III.
Army Engineer District, Baltimore, MD.
Available from the National Technical Information Service, Springfield, VA 22161 as AD-A036 855, Price codes: A10 in paper copy, A01 in microfiche. August 1972. 208 p, 17 Fig, 52 Tab, 20 Exhibits, 30 Ref.

Descriptors: *Water resources planning, *Waste water treatment, *Water management(Applied), *Water pollution control, *Economic analysis, *Codorus Creek(PA), *Water pollution, *Water quality, *Land treatment, Economics, Social aspects, Water use, Comprehensive planning, Pennsylvania, Cost analysis, Management alternatives, Treatment facilities, Water reuse, Sludge disposal, Costs.

The Codorus Creek Wastewater Management study was undertaken to recommend actions necessary to improve significantly the water quality of the creek in order to provide a basis for restoration of natural environmental values and enhancement of the economic and social needs of the people. The Codorus stream system, which is severely degraded, covers 280 square miles in southern Pennsylvania. This appendix investigates wastewater management for industrial and municipal discharges to the Codorus Creek Basin. Wastewater flow projections were developed for each of the 16 service areas for the years 1980, 1990, 2000 and 2020. Total wastewater flows are projected to increase 165% in the year 2000 over current levels. Water quality management objectives are presented for the study area in terms of water quality stream standards, existing action plans, and water quality performance criteria. Technological alternatives for wastewater system design are examined. The basic technologies available to meet long-range objectives encompass advanced water process treatment and land treatment through irrigation. Performance capabilities of these systems are evaluated for cost and performance relationships relative to present and long-range water quality management objectives. Physical characteristics are examined for suitability for wastewater applications. Water reuse is examined as an alternative for conservation of available water supplies and maintenance or enhancement of stream flows. Five of the most promising wastewater system management alternatives are analyzed and cost evaluations presented for each alternative. (Arnold-NC)
W80-04175

THE CODORUS CREEK WASTEWATER MANAGEMENT STUDY--APPENDIX A. TECHNICAL STUDIES, VOL. IV.
Army Engineer District, Baltimore, MD.
Available from the National Technical Information Service, Springfield, VA 22161 as AD-A036 856, Price codes: A12 in paper copy, A01 in microfiche. August 1972. 266 p, 7 Fig, 57 Tab, 35 Exhibits.

Descriptors: *Water resources planning, *Waste water treatment, *Water management(Applied), *Water pollution control, *Economic analysis, *Codorus Creek(PA), *Water reuse, *Land treatment, Economics, Social aspects, Water quality, Water use, Comprehensive planning, Pennsylvania, Primary treatment, Secondary treatment, Tertiary treatment, Stormwater management, Treatment facilities, System design, Sludge disposal, Costs, Maintenance costs, Operating costs.

The Codorus Creek Wastewater Management study was undertaken to recommend actions necessary to improve significantly the water quality of the creek in order to provide a basis for restoration of natural environmental values and enhancement of the economic and social needs of the people. The Codorus stream system, which is severely degraded, covers 280 square miles in southern Pennsylvania. Analysis of wastewater management problems and possible solutions led to formulation and analysis of a broad range of technology and design alternatives. These encompassed a range of specific solutions advocated for the area and basic technology choices for achieving high wastewater management standards, alternative levels of performance capability and a broad range of constitutional management choices. This appendix considers five specific alternative plans: (1) Plan to Meet Current Standards; (2) All Water Treatment Plan; (3) All Land Treatment Plan; (4) December Plan--a combination of the All Water and All Land Plans; and (5) Reuse Plans. Facilities plans and projected costs are presented for each plan. Sludge management and industrial wastes management plans are also presented. Three options are discussed for the Reuse Plan. A Stormwater Management Plan is presented for the Basin including operation and maintenance costs for the plan. (Cooper-NC)
W80-04176

THE CODORUS CREEK WASTEWATER MANAGEMENT STUDY. APPENDIX B. IMPACT STUDIES.
Army Engineer District, Baltimore, MD.
Available from the National Technical Information Service, Springfield, VA 22161 as AD-A036 857, Price codes: A08 in paper copy, A01 in microfiche. August 1972. 164 p, 16 Fig, 14 Tab, 98 Ref.

Descriptors: *Water resources planning, *Waste water treatment, *Water management(Applied), *Water pollution control, *Economic analysis, *Codorus Creek(PA), *Water quality, Economics, Social aspects, Water use, Comprehensive planning, Pennsylvania, Aquatic ecology, Terrestrial ecology, Public health, Benthic organisms, Social impacts, Economic impacts, Environmental impacts.

The Codorus Creek Wastewater Management study was undertaken to recommend actions necessary to improve significantly the water quality of the creek in order to provide a basis for restoration of natural environmental values and enhancement of the economic and social needs of the people. The Codorus stream system, which is severely degraded, covers 280 square miles in southern Pennsylvania. This appendix describes the assessment and evaluation of impacts of several alternative wastewater management plans for the Basin. The four basic plans were (1) a decentralized water-oriented system, (2) a centralized water-oriented system, (3) a combination water-land system, and (4) an industrial reuse water-land system. Six impact areas were selected: economic, social, aquatic ecology, terrestrial ecology, visual, and public health risk. Within the economic and social impact areas, short- and long-term economic stimulation, employment, housing and public service, leisure opportunities, agriculture, land use, land values and visual (direct and indirect) impacts were considered. All four plans would have positive effects on short- and long-term economic stimulation, employment, leisure opportunities, and aquatic ecology. Plans (3) and (4) would have negative effects on housing and public service, land values and direct visual impacts. All four alternatives would greatly enhance the indirect visual-resultant water quality attributes of the Creek. Aquatic ecology would be enhanced, with a decrease in potential eutrophication. Terrestrial ecology impacts would be positive; management of interceptor rights-of-way could be handled to provide low level vegetation for small game habitats. All alternatives should reduce microbial contamination but land disposal might have adverse public health effects. (Cooper-NC)
W80-04177

THE CODORUS CREEK WASTEWATER MANAGEMENT STUDY. APPENDIX C. ANALYSIS OF INSTITUTIONAL ARRANGEMENTS.
Army Engineer District, Baltimore, MD.
Available from the National Technical Information Service, Springfield, VA 22161 as AD-A036 858, Price codes: A03 in paper copy, A01 in microfiche. August 1972. 45 p, 5 Fig, 3 Tab, 4 Attachments.

Descriptors: *Water resources planning, *Wastewater treatment, *Water management(Applied), *Water pollution control, *Economic analysis, *Codorus Creek(PA), *Water quality, Economics, Social aspects, Water pollution, Water use, Comprehensive planning, Governments, Institutional arrangements, Legal aspects, Financial aspects.

The Codorus Creek Wastewater Management study was undertaken to recommend actions necessary to improve significantly the water quality of the creek in order to provide a basis for restoration of natural environmental values and enhancement of the economic and social needs of the people. The Codorus stream system, which is severely degraded, covers 280 square miles in southern Pennsylvania. This appendix presents an overview of the interrelationship of various agencies which will be involved in implementing and managing any given wastewater treatment alternatives in the Basin. There are currently 14 existing wastewater management authorities in the study area. Some kind of unifying institution would have to be established to provide centralized leadership for basin-wide action on wastewater. Legal analysis for expanding present or developing new institutions is presented. This analysis discusses municipal powers for construction and operation of wastewater treatment facilities, including the formation of water authorities and land acquisition powers. Four institutional alternatives are presented, along with probable impacts, ranging from total decentralization to complete centralization; these alternatives are discussed within existing and pending legislation. Potential sources of financial assistance are examined, including Federal, state and local programs. Conclusions indicate that the most attractive institutional arrangement for wastewater management in the Basin would be a County Wastewater Authority. (Arnold-NC)
W80-04178

THE CODORUS CREEK WASTEWATER MANAGEMENT STUDY. SUPPLEMENT TO APPENDIX C. IMPLEMENTING A LAND-BASED SYSTEM--AN ANALYSIS OF APPROACHES.
Army Engineer District, Baltimore, MD.
Available from the National Technical Information Service, Springfield, VA 22161 as AD-A036 859, Price codes: A02 in paper copy, A01 in microfiche. August 1972. 24 p, 8 Tab.

Descriptors: *Water resources planning, *Waste water treatment, *Water management(Applied), *Water pollution control, *Economic analysis, *Codorus Creek(PA), *Water quality, Economics, Social aspects, Wastewater irrigation, Water pollution, Water use, Comprehensive planning, Pennsylvania, Land management, Land treatment.

The Codorus Creek Wastewater Management study was undertaken to recommend actions necessary to improve significantly the water quality of the creek in order to provide a basis for restoration of natural environmental values and enhancement of the economic and social needs of the people. The Codorus stream system, which is severely degraded, covers 280 square miles in southern Pennsylvania. This volume provides additional information with regard to implementing a land-based wastewater management system in the Basin. Alternatives for land acquisition and management are discussed and action proposals are made involving individual and joint municipal efforts, formation of a municipal authority, or contracting with a private corporation for development of the

system. Land-spreading alternatives for wastewater in York County are examined in relation to existing farm size, ownership, and farm operator information. A particular area, Census Tract 217, is mentioned as a candidate for irrigation of treated wastewaters. Various potential management concepts are outlined to meet stated goals of minimizing human relocation due to plant construction, maintaining or improving the local tax base, stabilizing rural community values, and increasing on-farm income by land spreading. (Arnold-NC)
W80-04179

WATER QUALITY AND MINING: A MANAGEMENT PLAN.
North Carolina Dept. of Natural Resources and Community Development, Raleigh. Div. of Environmental Management.
December 1979. 59 p, 8 Fig, 4 Tab, 24 Ref.

Descriptors: *Water quality, *Mining, *North Carolina, *North Carolina Mining Act of 1971, *Sedimentation, *Mine wastes, *Sedimentation control, *Water pollution sources, Mines, Water management(Applied), Planning, National Pollutant Discharge Elimination System, Pollutants, Pollution, Erosion, Waste disposal, Pollution control, Nonpoint source pollution.

This document is an assessment of mining practices in North Carolina and their effects on water quality. Of the 507 mines in the State that affected more than 11,695 acres of land in 1978, all but one produced non-metallic minerals and no coal mining was undertaken. The control and treatment of point source discharges from mining operations has been greatly improved through the National Pollution Discharge Elimination System and the State's Mining Act of 1971. Potential adverse effects of mine operations include acid drainage, drastic landscape alteration, displacement of wildlife and soil erosion resulting in offsite sedimentation. In North Carolina mining, the potential adverse effect of the most widespread concern is offsite sedimentation of inorganic solids. The primary objective of the mining program in the State is to assure the reclamation of areas disturbed by mining within two years after the completion of mining. Best management practices for mining include use of vegetation, diversions, erosion control on haul roads, erosion control on spoil piles and tailings, buffer strips, seasonal restrictions, erosion control at abandoned mine sites, and silt fences. (Iervolino-NC)
W80-04180

IMPACT OF NONPOINT POLLUTION CONTROL ON WESTERN LAKE SUPERIOR, RED CLAY PROJECT, FINAL REPORT: SUMMARY,
Environmental Protection Agency, Chicago. IL. Great Lakes National Program Office.
For primary bibliographic entry see Field 2J.
W80-04181

INTERACTIVE POLLUTANTS AND JOINT ABATEMENT COSTS: ACHIEVING WATER QUALITY STANDARDS WITH EFFLUENT CHARGES,
Newcastle-upon-Tyne Univ. (England). Dept. of Economics.
B. Beavis, and M. Walker.
Journal of Environmental Economics and Management, Vol 6, No 4, p 275-286, December 1979. 2 Fig, 13 Ref.

Descriptors: *Water pollution control, *Interactive pollutants, *Joint abatement costs, *Water quality, *Effluent charges, *Analysis, *Water quality control, Abatement, Pricing policy, Taxes, Pollution abatement, Model studies, Hydrologic models, Control, Water pollution abatement.

The authors study water pollution control by considering simultaneously spatial considerations, interactive pollutants, and joint abatement costs. Analysis is confined to pollutants which exert either an acute toxicity effect or a dissolved oxygen demand or both. Two forms of environmental constraint are specified. One, designed to deal with non-interacting pollutants, places upper bounds on the allowable levels of concentrations of certain pollutants in a given stretch of the water course. The second set of constraints is designed to handle explicitly the case of interactive pollutants. Satisfactory resolution of water pollution control problems requires that discharges of pollutants at any point in the water course be related to ambient concentrations of toxicity and dissolved oxygen in each stretch of the water course. Hydrological modeling techniques have demonstrated the possibility of making predictions of this kind. The analysis in this paper raises serious doubts about the practicability of an iterative pricing policy taking place in real time for determining the appropriate tax to be levied on polluting discharges in order to achieve specified levels of water quality. (Iervolino-NC)
W80-04187

6. WATER RESOURCES PLANNING

6A. Techniques Of Planning

THE DEVELOPMENT OF PALIS: A PONDS AND LAKES INFORMATION SYSTEM FOR MASSACHUSETTS,
Massachusetts Univ., Amherst. Water Resources Research Center.
P. J. Godfrey, S. A. Joyner, Jr., E. L. Goldstein, and L. Ross.
Available from the National Technical Information Service, Springfield, VA 22161 as PB80-156979, Price codes: A12 in paper copy, A01 in microfiche. Publication No 108, 1979. 236 p, 10 Fig, 3 Tab, 26 Ref, 22 Append. OWRT A-124-MASS(1), 14-34-0001-9023.

Descriptors: *Management information systems, *Data storage and retrieval, *Information retrieval, *Ponds, *Lakes, Electronic data processing, Automatic data processing, Water management(Administrative), Water management(Applied), Water resources planning, Computer programs.

The present study deals with the design of a state-of-the-art information system for managing ponds and lakes resources at the state level. Accomplishing this goal for Massachusetts entailed the completion of 4 separate tasks: (1) To assess the quality and quantity of ponds and lakes information existing in Massachusetts. (2) To survey the 'state of the art' of computerized management information systems including water resources information systems. (3) To evaluate the implications for Massachusetts state agencies of computerizing in a single system all the ponds and lakes information they already possess. (These implications involved the assessment of how the agencies' current ponds and lakes management decisions depended on ponds and lakes data, and how these decisions--and the data they depend on--could be expected to change in response to federal programs.) (4) To design a management information system for Massachusetts ponds and lakes information. This design included the creation of a complex data base structure which was suited to existing computer software packages, and the development of a functioning pilot demonstration system based on state agency data for 20 lakes and ponds. To our knowledge the Massachusetts Ponds and Lakes Information System (PALIS) is the first comprehensive statewide computerized information system for the management of ponds and lakes resources. The need it is designed to fill in Massachusetts exists in other states as well, and both the PALIS design process and the PALIS system are readily transferable to other states seeking to improve the management of their ponds and lakes resources.
W80-03902

GROUNDWATER BASIN MODELING USING THE FINITE ELEMENT METHOD - YOLO COUNTY CASE STUDY,
California Univ., Davis, Dept. of Agricultural Economics.
O. A. Bamgboye.
Available from the National Technical Information Service, Springfield, VA 22161 as PB-157 324, Price codes: A07 in paper copy, A01 in microfiche. MS Thesis, 1979, 126 p, 20 Fig, 6 Tab, 2 Append. (California Water Resources Center Project UCAL-WRC-W-526). OWRT-B-187-CAL(1).

Descriptors: *Groundwater, *Water management(Applied), *Finite element analysis, Analytical techniques, Algorithm, California, Aquifer management, Model studies, *Yolo County(Calif).

In order to effectively monitor and manage aquifers subjected to varying natural and artificial recharge as well as increased pumping demands, it becomes necessary to analyze their hydrodynamic response. In this study a regional two-dimensional flow analysis is formulated using finite element techniques. A general algorithm is described to handle confined or unconfined flow. The advantage of using finite element analysis for aquifer flows becomes evident when attempting to model irregular boundaries and variable inputs such as natural recharge, pumping and aquifer properties. Numerical solutions are presented which, when compared with known analytical results, verified the technique and showed some limitations of the model. An analysis is presented of flow in the aquifer systems underlying Yolo County, a region where time variable pumping and natural recharge do occur. Unconfined and confined groundwater flow analysis were employed to simulate the hydrodynamic response of the Yolo County aquifer systems. The Galerkin time step scheme formulation was found applicable for small time steps. Based on minimization of differences between recorded and computed groundwater levels, the confined analysis using reliable constant transmissivity values is regarded as the most appropriate model for the aquifer systems. (Snyder-Calif)
W80-03904

OPTIMAL ALLOCATION OF WATER RESOURCES IN AN INPUT-OUTPUT FRAMEWORK: USER'S MANUAL,
Colorado State Univ., Fort Collins. Dept. of Civil Engineering.
T. Jonch-Clausen, and H. J. Morel-Seytoux.
Available from the National Technical Information Service, Springfield, VA 22161 as PB80-158264, Price codes: A12 in paper copy, A01 in microfiche. Interim Report for FY 1977-1978, Report No CER 77-78TJ - HJM 23. March 1978, 259 p, 22 Fig, 17 Tab, 24 Ref, 3 Append. OWRT B-115-COLO (5).

Descriptors: *Water allocation(Policy), *Planning, *Input-output analysis, *Computer models, Mathematical models, Hydrology, Water resources, Water policy, Cost analysis, Colorado, Computer programs, Simulation analysis, Water demand, Water supply, Optimization.

Planner oriented instructions are given for the use of a methodology for the optimal allocation of water resources in a region. The methodology uses a piecewise quadratic programming approach in an input-output framework to model the highly interdependent hydrologic processes governing the distribution and movement of water in natural systems. The methodology is general and applicable to a variety of situations so that the planner can formulate his particular problem. The model is designed to integrate the input-output description of a regional water resource system with the appropriate optimization approach and can handle a variety of cases such as: (1) single or multiperiod allocations, (2) minimization of expected or uncertain costs, and (3) power costs functions or simple linear or quadratic cost functions. A flow chart of the model describes the steps to be taken by the user as well as the model operations. A highly simplified conceptualization of the Cache la Poudre River basin in northern Colorado is used to illustrate the mathematical formulation of a planning problem and the computerized solution of the problem. The characteristics of the water resources of this basin are described along with sample inputs and outputs. Program listing for a single-period and a dual-period allocation model are given along with program flow charts for the FORTRAN IV Program. (Seigler-IPA)

W80-03915

A STOCHASTIC DESCRIPTION OF WET AND DRY SPELLS IN TERMS OF AN EFFECTIVE NUMBER OF DAYS,
Royal Netherlands Meteorological Inst., De Bilt.
H. A. R. De Bruin.
Journal of Hydrology, Vol 45, No 1/2, p 91-99, January 1980. 2 Fig, 2 Tab, 3 Ref, 1 Append.

Descriptors: *Stochastic processes, *Persistence, *Rainfall, Hydrologic data, Hydrology, Rain, Climatology, Meteorology, Synthesis, Frequency, Distribution patterns, *Stochastic description, *Hydrological studies, Climatological studies, Meteorological forecasting, Wet days, Dry days, Random variables.

The influence of persistence on the length of dry and wet spells is shown. A sequence of wet and dry days was treated as a binary process with the value 1 if a day was wet and a value of 0 if a day was dry. A day was called dry when the rainfall amounted to less than 0.25 mm. Other days were called wet. It was shown empirically that for the description of this influence an effective number of days can be used, similar to that of a previous study of Chapman and Bartels, which accounts for the effect of persistence on the variance of mean values. An empirical autocorrelation function was used to reduce the number of parameters. In this form the proposed model contained two parameters. These were the overall probability that a day is dry or wet and a parameter that accounts for persistence. In an appendix an infinite sequence of wet and dry days was considered, on the condition that the mean length of wet and dry runs was infinite. (Roberts-ISWS)
W80-03938

INCORPORATION OF PERCEPTUAL STANDARDS INTO A WATER QUALITY INFORMATION SYSTEM,
Auburn Univ., AL. Dept. of Accounting and Finance.
S. H. Dinius.
In: Proceedings of Third World Congress on Water Resources, Mexico City, Mexico, April 1979. Vol 4, p 1745-1954, 1979. International Water Resources Association, Mexico City. OWRT A-054-ALA(1).

Descriptors: *Pollution, Statistical analysis, Visual pollution, *Water quality, *Water quality index, Water pollution index, Litter pollution, Water quality control, *Visual performance test, Water quality system.

Laymen's perceptual evaluation of varying levels of pollution was measured utilizing a specially designed visual performance test. The test contained water site photographs in which pollution levels were systematically varied. Statistical analysis using analysis of variance and Duncan's Multiple Range Test indicated that subjects evaluation of each water site's level of pollution varied significantly with the quantity of artificial pollution placed there by investigator. Factor analysis isolated three determinants related to human perception of water site quality. One factor was incorporated into a previously designed water quality system which originally linked together chemical analysis of 11 important water pollutants with detrimental effects of the pollutants. The result is one unified water quality system in which water scientists evaluate polluting effects of chemically analyzable pollutants, and laymen evaluate elements related to human value such as obvious pollution.
W80-03966

ENVIRONMENTAL PROBLEMS OF DEVELOPING COUNTRIES,
Urban Development Inst., Bombay (India).
For primary bibliographic entry see Field 6E.
W80-03969

THE WORTH OF STREAMFLOW DATA IN WATER RESOURCES PLANNING: COMPUTATIONAL RESULTS,
Case Western Reserve Univ., Cleveland, OH.
For primary bibliographic entry see Field 2E.
W80-04019

SIMULATED CHANGES IN GROUND-WATER LEVELS AND STREAMFLOW RESULTING FROM FUTURE DEVELOPMENT (1970 TO 2020) IN THE PLATTE RIVER BASIN, NEBRASKA,
Geological Survey, Lincoln, NE. Water Resources Div.
E. G. Lappala, P. A. Emery, and F. J. Otradovsky.
Geological Survey Water-Resources Investigations 79-26 (open-file report), 1979. 82 p, 36 Fig, 11 Tab, 16 Ref.

Descriptors: *Groundwater mining, *Model studies, *Water resources development, *Projections, *Water levels, *Streamflow, Nebraska, Aquifer characteristics, Evapotranspiration, Aquifer systems, Pumping, Water wells, Drawdown, Groundwater recharge, Specific yield, Groundwater availability, Water utilization, Surface-groundwater relationships, Geomorphology, Irrigation, Evaluation, *Platte River basin(Nebr), *The Stream-Aquifer Hydrology Task Force.

Future changes in ground-water levels and streamflow caused by a limited set of water-resources development conditions were simulated with digital models of stream-aquifer systems within the Platte River basin, Nebraska. Simulated water-resources use in the basin included private development of ground water for irrigation, and development of ground water to supply municipal demands of Lincoln and Omaha. Simulated future conditions indicate that significant permanent declines in ground-water levels and streamflows may occur as a result of private development of ground water for irrigation. The largest simulated declines in ground-water levels were more than 80 feet by the year 2020 in upland areas in the Elkhorn and Middle Platte subbasins under conditions of rapid development of all irrigable lands. Simulated depletion of perennial streamflows by ground-water withdrawals indicated that future surface-water supplies may be limited in parts of the basin. Simulated depletions to major streams exceeded 60 percent of average perennial flow in the Elkhorn subbasin under conditions of rapid private development of ground water for irrigation. Simulations that evaluated the effects of combined private ground-water development with proposed Federal development of surface water for irrigation showed that in the project areas, ground-water level declines were reduced compared to 'without project' conditions. In some project areas, simulated ground-water level rises would lead to waterlogged conditions in parts of the Middle Platte subbasin. (Kosco-USGS)
W80-04096

CONSTRUCTION AND APPLICATION OF A WATER QUALITY MODEL FOR THE UPPER BLACKFOOT RIVER BASIN IN THE CARIBOU NATIONAL FOREST, IDAHO,
Idaho Univ., Moscow.
H. Singh.
Available from the National Technical Information Service, Springfield, VA 22161 as PB80-161268, Price codes: A12 in paper copy, A01 in microfiche. Doctoral Dissertation, November 1979. 252 p, 28 Fig, 19 Tab, 59 Ref, 5 Append. OWRT C-7651 (No 7253)(2).

Descriptors: *Idaho, *Mathematical models, *Mining, *Fertilizers, *Phosphates, Watershed(Basins), Water pollution, Hydrologic data, Model studies, Water quality, Inflow, Discharge(Water), Environmental effects, Blackfoot River.

A steady state, deterministic and one-dimensional water quality model was developed as a management tool for future phosphate mining and processing operations in the Upper Blackfoot River basin. As the demand for phosphate continues to increase and old currently mined areas are depleted it is anticipated that phosphate mining operations in the Upper Blackfoot River basin will increase. Careful management of these mining operations will be needed to minimize or avoid the expected deterioration of water quality in streams of the area. The Boise River water quality model was modified to make it suitable for the Blackfoot River. The model, which is based on the concept of Continuously Stirred Tank Reactor, requires that the river be segmented while the steady-state inputs for atmospheric, hydrologic, and water quality simplify calculations and reduce computational time. The model was calibrated and verified using meteorological, hydrologic and water quality data from two periods in 1976. Given the limitations of the observed data and the complexity of the ecosystem involved, the model was found to be satisfactory. Using hypothetical arbitrary waste discharges at selected points in the basin the model was used to simulate the effect on stream water quality. For greater model accuracy improvements in the data collection system in the basin are needed such as: (1) coordination of various agency data collection programs, (2) additional hydrologic and water quality data collection on ungaged streams, and (3) collection of essential weather data. (Seigler-IPA)
W80-04105

A QUANTITATIVE ANALYSIS OF STREAMFLOW: THE IMPORTANCE OF PRECIPITATION AND GEOMORPHIC FACTORS IN DETERMINING YIELDS FROM SMALL WATERSHEDS,
Idaho Univ., Moscow. Coll. of Letters and Science.
J. J. Kuska.
Available from the National Technical Information Service, Springfield, VA 22161 as PB80-160609, Price codes: A03 in paper copy, A01 in microfiche. Idaho Water Resources Research Institute, University of Idaho Technical Completion Report, February 1980. 27 p, 7 Fig, 8 Tab, 11 Ref. OWRT A-062-IDA(1), 14-34-0001-8014.

Descriptors: *Streamflow forecasting, *Small watersheds, *Idaho, *Rocky Mountains(Idaho), *Regression analysis, Precipitation(Atmospheric), Flow characteristics, Runoff, Channel morphology, Topography, Vegetation, Land use, Watersheds(Basins), Water resources development, Northern Idaho, Meadow Creek basin(Idaho).

Stream flow data from 12 drainage basins located in the rocky mountains in Northern Idaho that covered 12.43 square miles were statistically analyzed and related to factors such as basin length, basin area, square miles, relief ratio, and precipitation levels. The resulting linear regression (R-square value of .87) indicates that geomorphic factors as well as precipitation play a dominant role in explaining variations in streamflow. The regression model was then applied to the much larger Meadow Creek watershed (approximately 243 square miles). The Thiessen method, which assumes linear variation of precipitation between stations and assigns each segment of area to the nearest station, was used to determine precipitation values for the Meadow Creek basin. The regression model, on a number of occasions produced a prediction that was similar to actual yield from the larger basin. (Gladwell-Idaho)
W80-04106

HYDROGEOLOGY AND COMPUTER MODEL OF THE BASS LAKE AREA, ST. CROIX COUNTY, WISCONSIN,
Wisconsin Univ.-Madison. Dept. of Geology and Geophysics.
For primary bibliographic entry see Field 2H.
W80-04111

TECHNICAL AND ECONOMIC EVALUATION OF AN MSF SOLAR ENERGY POWERED DESALINATION PLANT,
For primary bibliographic entry see Field 3A.
W80-04155

A CHANCE-CONSTRAINED GOAL PROGRAMMING MODEL TO EVALUATE RESPONSE RESOURCES FOR MARINE POLLUTION DISASTERS,
Texas Univ. at Austin. Center for Cybernetic Stud-

ies.
A. Charnes, W. W. Cooper, K. R. Karwan, and W. A. Wallace.
Journal of Environmental Economics and Management, Vol 6, No 3, p 244-274, September, 1979. 4 Fig, 5 Tab, 23 Ref, 1 Append.

Descriptors: *Water pollution, *Mathematical models, *Risks, *Oil spills, *Disasters, Economics, Coasts, Planning, Management, Evaluation, Equipment, Budgets, Waste water(Pollution), Decision making, Probability, Computer programs, Equations, Coast Guard regulations, Dynamic programming.

A model is described for budgetary planning for marine pollution disasters, specifically oil spills; how the model evaluates these risks and their associated performance quality levels is also shown. This model aids Coast Guard managers in formulating policies concerning equipment required to contain major pollution incidents. The combined chance constrained-goal programming model is called Spill Incident Model (SIM). Oil spillage is defined in terms of response stages: pumping (off-loading), containment and removal. The paper describes several model details including (1) accounting constraints which enumerate the oil spill in storage and oil spilled, spilled oil that is contained, oil off-loaded from storage, and oil removed; (2) constraints that relate to equipment deployed to oil contained, removed and unloaded; (3) limitational constraints on available resources for various time periods; (4) probablistic constraints to equipment needs; and (5) goal constraints. Goal programming allows plans to come as close as possible to desired quality and risk levels for each pertinent region and incident type. Coast Guard equipment for marine pollution disasters include skimmers, containment booms, a self-contained high-speed pumping system called ADAPTS and various chemical dispersants. (Danovich-Wisconsin)
W80-04164

OPTIMAL WATER USE AND SALINITY CONTROL FOR ENERGY--UPPER COLORADO RIVER BASIN,
Arizona Univ., Tuscon. Dept. of Soils, Water and Engineering.
M. Flug, W. R. Walker, and G. V. Skogerboe.
Water Resources Bulletin, Vol 15, No 4, p 964-973, August 1979. 5 Fig, 9 Ref. OWRT C-6076 (No 5211)(3).

Descriptors: *Water management(Applied), *Optimization, *Mathematical models, *Water resources, *Energy development, *Upper Colorado River, *Colorado, Salinity, Oil shale, Coal, Modelling, Management, Linear programming, Water utilization, Efficiencies, Water demand.

The Upper Colorado River Basin contains significant amounts of undeveloped fuel resources. Development of these resources requires an adequate water supply. Present water quality is at a concentration where increased salinity would result in economic detriment to holders of downstream water rights. A mathematical model has been developed to assess the relationships between water availability in the Basin, salinity, energy production, and the economics of development. Alternative scenarios regarding synthetic fuel production are evaluated in terms of differential energy development costs, various institutional constraints, and restrictions pertaining to water use and water quality distribution. Water-related data include the quantity of water available, the average salinity, and the contribution of precipitation to the river system. Water quality control involves managing salinity impacts upon the remaining flows of the Colorado River. Actual salinity impacts resulting from energy developments can be broken down into three primary sources: water consumption, return flows, and disturbed land areas. The structure of the energy-water-salinity problem formulation is represented by a set of linear equations and inequalities which can be solved by linear programming techniques. The salt and water exchanges in mining, processing, and spent fuel disposal processes have been incorporated as part of a two-level minimum cost linear programming algorithm. The simulation provides an optimal use of Upper Colorado River water for levels of energy output such that salinity concentrations are maintained below predetermined levels. (Iervolino-NC)
W80-04190

6B. Evaluation Process

BENEFITS OF LONG-RANGE STREAMFLOW PREDICTION,
California Univ., Los Angeles. Dept. of Systems Engineering.
W. W-G. Yeh, L. Becker, M. J. Cohn, and R. Zettlemoyer.
Available from the National Technical Information Service, Springfield, VA 22161 as PB80-156276, Price codes: A31 in paper copy, A01 in microfiche. California Water Resources Center, University of California, Davis Technical Completion Report, Contribution 181, February 1980, 31 p, 11 Fig, 9 Tab, 2 Append. (California Water Resources Center Project UCAL-WRC-W-535).

Descriptors: *Streamflow forecasting, *Multiple-purpose reservoirs, *Surface water, *Groundwater, Streamflow, Reservoirs, Water supply, Water storage, Available water, Projections, California.

This study supplements Department of Water Resources Projects Hydrospect and Hydrospect II by assessing improved benefits that might be gained from the use of long-range streamflow forecasts in the operation of a typical multipurpose reservoir. Long-range is defined as a period of time ranging from one month to one year. The Oroville-Thermalito reservoir system is selected for study; major benefits to be derived from long-term streamflow prediction for this system are hydropower generation; water conservation for irrigation and/or other beneficial uses; and decreased seepage damage to crops. Flood control benefits are potentially high but those benefits are more amenable to short-term rather than long-term forecasting. Incremental benefits are determined as functions of forecast time and accuracy on the basis of general adherence to current operating rules. The reservoir is theoretically operated over the 1914-73 time period; forecasts and comparisons are based on the historical streamflows. Procedure failure is defined as inability to meet a minimum storage constraint at any time over the 60 year period. To provide an additional evaluation of benefits from forecasting, analyses are also made using the historical means as estimates of future streamflows. This study also explores, quantitatively, the economic benefits from optimal operation of the surface water/groundwater system, given advance estimates of future surface water supplies. (Snyder-California)
W80-03901

PARTICIPATION IN WATER RESOURCES PLANNING: LEADER AND NON-LEADER COMPARISONS,
Purdue Univ., IN. Dept. of Sociology and Anthropology.
H. R. Potter, G. M. Grossman, and A. K. Taylor.
Available from the National Technical Information Service, Springfield, VA 22161 as PB80-156128, Price codes: A03 in paper copy, A01 in microfiche. Purdue University Water Resources Research Center Technical Report No 107, 1980. 33 p, 13 Tab, 27 Ref. OWRT A-053-IND(1).

Descriptors: Social participation, Economic models, *Water resources, *Political aspects, *Social aspects, Environment, Model studies, Community leaders, *Public participation, Non-leaders, *Environmental problems.

The purposes of this research are to provide descriptive comparisons of community leaders and the general public on (1) how they perceive environmental problems, (2) how they view opportunities for citizen participation, (3) the extent to which they participate in decision making, and (4) to compare alternative models of community decision making. Data are from personal interviews with 46 leaders and a sample of 139 residents of Tippecanoe County, Indiana. The differences between leaders and the public were not generally great in how they see environmental problems, however, leaders who see problems are more concerned, although they are more likely to think pollution will improve in the near future. The public is more likely to think not enough is being done. Both groups support citizen participation, however leaders participate much more than the public. Nevertheless, both evaluate the effectiveness of techniques for political participation similarly. Two models of community decision making, knowledge-participation and socio-economic models, produce similar, mixed results in explaining environmental attitude. A model that combines the variables of both of these models does somewhat better, but still varies depending on the indicator of the dependent variable. Political participation, leadership and education each have independent effects in the regression model where R is statistically significant. Greater participation and more education leads to perceiving more environmental problems, while leaders perceive fewer problems. Problems of measuring environmental attitude are discussed.
W80-03903

PUBLIC PARTICIPATION IN THE NORTH CAROLINA STATEWIDE 208 WATER QUALITY PLANNING PROGRAM: AN EVALUATION OF THE PROBLEM IDENTIFICATION PHASE OF PLANNING,
North Carolina Univ. at Chapel Hill. Dept. of City and Regional Planning.
B. Stiftel, S. Herzberg, and D. R. Godschalk.
Available from the National Technical Information Service, Springfield, VA 22161 as PB80-157597, Price codes: A08 in paper copy, A01 in microfiche. Water Resources Research Institute, University of North Carolina. Working Paper No 75, June 1979. 146 p, 57 Fig. OWRT-A-096-NC(2), 14-34-0001-8035.

Descriptors: *Water quality control, *Planning, Costs, Evaluation, Programs, Public participation, *North Carolina, *Water quality planning program.

The Problem Identification phase of an analysis of the public participation effort of the North Carolina statewide '208' water quality planning program is presented. The analysis was based on 7 criteria: accessibility, involvement, public awareness, staff awareness, effect on staff and plan, effect on public and plan, and cost. The major results indicate that the public participation program was successful from the viewpoint of both planners and participants. Findings with respect to 10 participation methods, including circulation reports, meetings, goal setting workshops and advisory committees, are presented.
W80-03909

THE PYRAMID LAKE-NEWLANDS PROJECT CONTROVERSY, 1903-1926,
Nevada Historical Society, Reno.
J. M. Townley.
Available from the National Technical Information Service, Springfield, VA 22161 as PB80-157928, Price codes: A02 in paper copy, A01 in microfiche. Water Resources Center, University of Nevada System, Reno. Completion Report, February 1980, 9 p. OWRT A-074-NEV(1), 14-31-0001-7060.

Descriptors: *Nevada, *Irrigation programs, *Federal project policy, *Water policy, Land reclamation, History, Indian reservations, Land use, Water storage, Water supply, Water users, Water demand, Lake Tahoe, Pyramid Lake, Carson River, Truckee River.

Historical records were used to study the Newlands Project, Nevada's initial Federal reclamation project, during the period 1903 through 1926. Since 1903 there has been controversy over the allotment of Truckee River water among users. In 1923 the Bureau of Reclamation turned over operational control of the project to the locally directed Truckee-Carson Irrigation District. Early U.S. Department of Interior actions to supply water to the Newlands Project and the effect on Pyramid Lake, now the Pyramid Lake Paiute Reservation,

were studied. Records from newspapers, archival collections, and various Federal agencies were used to investigate the problems encountered in construction of the Truckee-Carson Project, the struggle for control of Lake Tahoe as a storage reservoir, and the treatment of the Paiute as a homesteader on the project. From this historical study three publications were prepared that will probably be consulted when the litigation concerning the Truckee-Carson Irrigation District, the Pyramid Lake Pauite Reservation, and the water users of the Truckee and Carson Rivers is examined in Federal court. The study shows that original estimates of potentially reclaimable acreage were high and the actual 60,000 acres reclaimed are not enough to economically justify the creation of the project. Failure to purchase control of the Tahoe City dam forced up land prices in the reclamation district from $22/acre to over $100/acre. The Paiute Indians lost approximately 30,000 acres, were excluded from entry within the project, and were isolated on a reservation with no consideration of Winters Doctrine rights. (Seigler-IPA)
W80-03917

UNDEVELOPED HYDROPOWER AS A POTENTIAL ENERGY SOURCE IN IDAHO,
Idaho Univ., Moscow. Water Resources Research Inst.
C. C. Warnick, and L. F. Heitz.
Available from the National Technical Information Service, Springfield, VA 22161 as PB80-157399, Price codes: A03 in paper copy, A01 in microfiche. Research Technical Completion Report, November 1979. 24 p, 3 Fig, 5 Tab, 10 Ref. OWRT A-057-IDA(2).

Descriptors: *Idaho, *Pacific Northwest U.S., *Hydroelectric plants, *Electric powerplants, Hydroelectric power, Energy conversion, Flow duration, Flow measurement, Flow rates, Water resources, Hydrology, Regression analysis, Washington, Oregon, Montana, Wyoming, Nevada.

The potential energy available in both regulated and unregulated streams in Idaho and the Pacific Northwest through the use of small scale hydro development was surveyed. Increasing energy demands, the rising cost of fuels for steam power plants, and recent advance in the production of smaller units have combined to make the construction of small scale, low-head hydro developments a viable source of energy. For the survey a technique was developed to find flow duration information along reaches of streams that did not have flow records due to inadequate gaging. Also a method for estimating flow duration curves for regulated streams was developed and applied. To determine head for power computations the difference in elevation at the inflow and outflow points of a reach was used. Results showed that most plants would be of the run-of-river type installation. Synthetic flow duration curves were based on a technique of regression equation between flow of a given interval and the average annual flow. Parametric curves resulted from the unregulated stream flow duration curves. A preliminary social, political, and environmental feasibility evaluation was also made for each reach with theoretical energy potential. Summaries of the survey results are included. Data from the Idaho survey were catalogued and computerized for easy retrieval and processing. Considerable theoretical potential was found for small hydro in the state of Idaho. (Seigler-IPA)
W80-03918

AN ECONOMIC EVALUATION OF THE SALINITY IMPACTS FROM ENERGY DEVELOPMENT: THE CASE OF THE UPPER COLORADO RIVER BASIN,
Utah Water Research Lab., Logan.
R. Narayanan, S. Padungchai, and A. B. Bishop.
Available from the National Technical Information Service, Springfield, VA 22161 as PB80-159932, Price codes: A04 in paper copy, A01 in microfiche. Water Resources Planning Series UWRL/P-79/07, December 1979. 71 p, 20 Fig, 45 Tab, 2 Append. OWRT-B-141-UTAH(1), 14-34-0001-7192.

Descriptors: *Energy development, Water resources, *Salinity, *Mathematical models, *Economic feasibility, Cost-benefit analysis, Water allocation(Policy), Water quality, *Salinity reduction, Colorado River Basin, Upper Colorado River Basin.

To analyze the effect of potential energy development on water allocation and water quality in the Upper Colorado River Basin, a linear programming model is formulated. Using the model, changes in salinity are predicted. Further, least-cost strategies to maintain the established numeric salinity criteria through both structural and non-structural alternatives are developed. The effectiveness of alternative control measures are examined within given institutional constraints. Based on cost-benefit analysis, optimal salinity levels over time are proposed. The economic feasibility of presently planned structural measures to reduce salinity is investigated and contrasted with non-structural alternatives.
W80-03964

THE OPTIMAL MANAGEMENT OF TRANSBOUNDARY RENEWABLE RESOURCES,
British Columbia Univ., Vancouver.
G. R. Munro.
The Canadian Journal of Economics, Vol 12, No 3, p 355-376, August 1979. 2 Fig, 20 Ref.

Descriptors: *International waters, *Fisheries, *Mathematical models, *Fish management, *Boundary disputes, *Adjacent land owners, International law, Legal aspects, Foreign trade, Foreign waters, Economics, International Joint Commission, Joint costs, Optimization, Model studies, Payment, Royalties, Commercial fishing, Economics, Water law, Boundaries(Property), Fish harvest.

Optimal management of renewable resources such as a fishery is extended from an assumption of ownership and control by a single state to ownership by two adjoining political jurisdictions. Resource management conflicts are easier to resolve if one co-owner can make side payments to the other to balance interest. A dynamic model of fisheries is combined with Nash's theory of two-person co-operative games. Conflict in management strategies between the co-owners is viewed in terms of varying propensity of each state to invest or disinvest in the resource. Conflicting views on optimal stock or biomass on the part of each state implies disagreement over optimal harvest rates. Three kinds of management conflicts are considered: (1) differences in perceived social rates of discount, (2) different harvesting costs, and (3) varying consumer preferences. Additional research in regard to multinational resource ownership should be obtained for fishery resources off West Africa in the Atlantic or the tuna fishery in the Pacific. In addition, policy consequences of allowing parameters to fluctuate through time should be examined. Further, implications should be investigated of joint management programs of limited resource. Finally, numerous actual cases of jointly owned renewable resources are being created through the emerging system of 200-mile exclusive economic zones in coastal waters. (Harris-Wisconsin)
W80-03970

CULTURAL DIFFERENCES IN PERCEPTIONS OF ENVIRONMENTAL PROBLEMS,
State Univ. of New York at Buffalo. Dept. of Political Science.
N. E. McGlen, L. W. Milbrath, and H. Yoshii.
Technological Forecasting and Social Change, Vol 14, No 2, p 97-114, July 1979. 10 Tab, 7 Ref.

Descriptors: *Surveys, *Japan, *United States, *Environment, *Social aspects, Erie County(NY), Hamilton County(NY), Sampling, Political constraints, Environmental control, Regulation, Governments, Social values, Social participation, Political aspects, Attitudes, Policy.

Comparison of results of attitudinal and opinion surveys conducted in Japan and the United States show that perceptions about the environment vary according to prevailing national culture. In 1974 interviewing, a Japanese team polled a nationwide random sample; US polling was limited to samples in heavily industrial Erie County and environmentally unspoiled Hamilton County, both in New York. More than twice as many Japanese as Americans rank the environment as the first or second most important national problem. Several components widely perceived by Americans as part of the environmental problem (such as population growth, energy availability, urban blight) are considered irrelevant by Japanese. Thus Japanese define the environmental problem narrowly as pollution alone, while Americans give it a broader definition. Japanese are more likely to blame the government for pursuing a wrong policy (unlimited industrial expansion) in assigning causes for environmental problems; Americans are inclined to blame people such as themselves for personal carelessness in causing these problems. Expectedly, Japanese are also more likely to want the national government to solve the environmental problem; Americans prefer a greater degree of individual initiative. Americans are also much more likely than Japanese to take part in environmental cleanup campaigns and similar mass activities. It concludes that people who live in environmentally damaged cities of Japan are more likely than American to perceive environmental problems as serious and are more willing to accept strong governmental action to correct it. (Harris-Wisconsin)
W80-03973

THE COSTS AND BENEFITS OF WATER METERING,
International Bank for Reconstruction and Development, Washington, DC. Energy Water and Telecommunications Dept.
R. N. Middleton, R. J. Saunders, and J. J. Warford.
Journal of the Institution of Water Engineers and Scientists, Vol 32, No 2, p 111-122, March 1978. 3 Fig, 9 Ref, 2 Append.

Descriptors: *Cost-benefit analysis, *Instrumentation, *Domestic water, *Water consumption(Except consumptive use), Cost-benefit theory, Feasibility, Water conservation, Use rates, Water rates, Water utilization, Potable water, Cost analysis, Cost allocation, Tariff, Prices, Economics, Consumptive use, Asia, Developing countries, Costs, Water allocation(Policy).

The decision of whether or not to meter individual households, examined in this study in terms of its theoretical framework and exemplified with water management experiences from several Asian cities, is subject to cost-benefit analysis. Quantifiable benefits developed through water metering are reduced operating and maintenance costs of the existing water supply and wastewater disposal facilities; these benefits are realized through reduction of water usage in the metered households. Other metering benefits are more difficult to quantify; they include: (1) more equitable allocation of costs to users, (2) general water conservation, and (3) better-identified demand trends in metered geographic areas. Costs include those to suppliers (Meter purchase and installation, setting up repair and storage facilities, meter inventories and replacement) and those borne directly by consumers (reductions in wasteful water uses and general water consumption). Because little data is available on the relationship between consumption and price it is difficult to estimate the value of various costs. Decisions on whether to adopt metering should be made in terms of the amount of reduced consumption which is sufficient to justify metering costs (assuming that reductions occur in all cases if meters are installed in households). In all but one of six Asian cities studied, water metering was cost justified. (Harris-Wisconsin)
W80-03974

DEMINERALIZATION OF BRACKISH MUNICIPAL WATER SUPPLIES--COMPARATIVE COSTS,
Miller and Associates, Boulder, CO.
E. F. Miller.
Journal of the American Water Works Association, Vol 69, No 7, p 348-351, July 1977. 1 Fig, 4 Tab, 31 Ref.

Descriptors: *Water treatment, *Reverse osmosis, *Electrodialysis, *Comparative costs, *Municipal water, *Demineralization, Colorado, New Mexico, Texas, Brackish water, Impaired water quality, Ion exchange, Groundwater, Economics, Water purification, Water softening, Cost analysis, Value engineering.

Comparisons between 1970-73 and 1977 cost analyses for treating brackish groundwater in 13 municipalities in Colorado, New Mexico and Texas, reveals that reverse osmosis preceded by an ion-exchange dealkylation (softening) in the case of high salinity, is the most inexpensive process for lowering brackish water mineral content. In 1970-73 treatment costs ranged 6.9-41.5 cents/cu m. For four of the 13 municipalities electrodialysis was the least costly treatment process. Reverse osmosis was most cost-effective for four other municipalities. For the remaining five municipalities, the least costly process was either exchange softening and either electrodialysis of reverse osmosis in combination. Cost projections for 1977 ranged 9.8-51.5 cents/cu m. These are incremental costs above costs incurred for pumping, removing iron, softening and sterilizing groundwater supplies to these communities. Technological improvements and the increased cost of energy are the main reasons reverse osmosis has become the least-cost process. Reoptimization of reverse osmosis system designs to employ looser membranes is warranted because of rising energy costs. No such opportunities can be seen for lowering energy requirements for electrodialysis, and the competitive standing of such systems is now limited. (Harris-Wisconsin)
W80-03978

GEOPHYSICAL AND HYDROLOGIC PREDICTION OF FISSURING AND LAND SUBSIDENCE, SOUTH-CENTRAL ARIZONA,
Arizona Univ. Tucson. Dept. of Geosciences.
For primary bibliographic entry see Field 2F.
W80-04013

THE WORTH OF HYDROLOGIC DATA FOR NONOPTIMAL DECISION MAKING,
Arizona Univ., Tucson. Dept. of Hydrology and Water Resources.
D. R. Davis, L. Duckstein, and R. Krzysztofowicz.
Water Resources Research, Vol 15, No 6, p 1733-1742, December 1979. 4 Fig, 4 Tab, 22 Ref. NWS 6-35229, NSF ENG 76-20280.

Descriptors: *Hydrologic data, *Value, *Mathematical models, *Decision making, Sampling, Risks, Methodology, Analytical techniques, Networks, Systems analysis, Data collections, Planning, Estimating, Streamflow, Floods, Hydraulic structures, Culverts, Design, Tile drainage, Flood forecasting, Projects, Information-response system.

Data are of value in the design and operation of water resource projects because they provide information about uncertain states of nature. This information can in turn be used to reduce the risks inherent in the project. In this paper, risk calculations from the preposterior analysis of statistical decision theory were extended to cover nonoptimal decisions. Risk was measured in terms of the project objectives by embedding the data network into an information-response (IR) system. The value of addition or improvement to the data base was measured by the change in the risk. Measures of the performance of the IR system were developed. From these measures, the efficiency of the information subsystem, the response subsystem, and the overall IR system were defined. These concepts are illustrated by a simple example in which the additional data sample for estimating the 6 1/4-year flow was shown to have different values (negative in one case), depending on the estimation method or decision rule used. Five anomalies and paradoxes in the literature concerning the worth of data were explained. Within the framework of the information-response model and its measures of performance and efficiency, additional data always improve information efficiency but may increase or decrease response efficiency. The relative increase or decrease of these efficiencies determines the worth of additional data for nonoptimal decision making. (Humphreys-ISWS)
W80-04044

TERMINATION OF HYDROLOGIC DATA COLLECTION (A CASE STUDY),
Science and Education Administration, Tucson, AZ. Southwest Rangeland Watershed Research Center.
L. J. Lane, D. R. Davis, and S. Nnaji.
Water Resources Research, Vol 15, No 6, p 1851-1858, December 1979. 8 Fig, 3 Tab, 19 Ref.

Descriptors: *Hydrologic data, *Demonstration watersheds, *Research priorities, *Decision making, *New Mexico, *Arizona, Value, Precipitation(Atmospheric), Runoff, Methodology, Analytical techniques, Analysis, Management, Statistical methods, Homogeneity, Sampling, Networks, Terminating data collection.

The operation of seven experimental watersheds near Albuquerque, New Mexico, and Safford, Arizona, which only obtain data on precipitation and runoff, was examined to determine (1) if their operation should continue as is, (2) if their data collection abilities should be expanded, or (3) if their operation should be discontinued. The decision-making procedure is modeled in terms of the theory of 'bounded rationality' rather than classical optimization theory. The choice of alternatives was subject to three constraints: that the resources for data collection activities at Southwest Watershed Research Center would not be increased, that it be administratively feasible, and that no research program be seriously impaired. A problem-data matrix that showed the data needs for several research objectives was constructed. Based on this matrix and an estimate of the value of the research to the agricultural community, the three alternatives for the operation of seven watersheds were evaluated. Considering the constraint of no additional resources and of administrative feasibility, the alternative of closing the seven watersheds was the best. To check that the third constraint was not violated, regional studies were made to compare precipitation and runoff characteristics of the Safford and Albuquerque watersheds with other experimental watersheds. A Bayesian decision analysis on the worth of future data was made. The regional analysis and the Bayesian study showed that closure of the watersheds would be detrimental to the precipitation and runoff data base, but not to the extent of impairing research objectives. The Albuquerque and Safford watersheds were closed in June 1976. (Humphreys-ISWS)
W80-04049

A STATISTICAL APPROACH TO STATION DISCONTINUANCE,
Princeton Univ., NJ. Dept. of Civil Engineering.
For primary bibliographic entry see Field 2E.
W80-04050

WATER RESOURCES OF THE LOWER ELWHA INDIAN RESERVATION, WASHINGTON,
Geological Survey, Tacoma, WA. Water Resources Div.
For primary bibliographic entry see Field 2F.
W80-04086

ECONOMICS AND WATER CONSERVATION PART 2,
Department of the Interior, Washington, DC. Office of Minerals Policy and Research Analysis.
For primary bibliographic entry see Field 3D.
W80-04149

RECREATION AT THE MCCLELLAN-KERR ARKANSAS RIVER NAVIGATION SYSTEM,
Institute for Water Resources (Army), Fort Belvoir, VA.
L. G. Antle.
Water Resources Bulletin, Vol 15, No 5, p 1408-1417, October 1979. 1 Fig, 6 Tab, 9 Ref.

Descriptors: *Recreation, *Management, *McClellan-Kerr Navigation System, *Multiple-purpose reservoirs, *Social impact, *Arkansas River, Recreation demand, Land use, Benefits, Costs, Cost-sharing, Benefits, Costs, Regional development, Economic impact, Economics, Lakes, Employment, Income, Employment opportunities, Arkansas, Oklahoma, Water level fluctuations, Water utilization.

Analysis of recreation impacts of the McClellan-Kerr Arkansas River Navigation System during 1963-1976 show some rich benefits and substantial problems; results suggest that the share of financial resources obtained from recreational users should be increased and that management activities should be transfered from the Corps of Engineers to non-federal agencies. The physical system was designed to provide multiple purpose capability including flood control, hydroelectric power, navigation, water supply, recreation, and fish and wildlife enhancement. Project benefits include increases in employment, income, economic dvelopment and migration. Total regional employment has increased from 417,183 in 1960 to 518,464 in 1970. Aggregate recreation expenditures are estimated at $193 million in 1974 and $224 million in 1975. Social impact analysis shows that 200,000 persons were directly influenced to migrate into the area since 1970 because of job opportunities and recreation advantages. However, the same factors which contribute such dramatic beneficial impacts also lead to formidable management problems such as financing and staffing recreation programs and managing conflicts between desirable uses of multiple purpose systems. Recreation impacts place stress on Corps funds and staff, both of which are limited due to federal budget constraints. Heavily used recreational lakes are a continual source of public conflict with respect to lake levels for other uses such as holding flood flows or releases for power and water supply. The paper concludes with strategies for Corps policy. (Danovich-Wisconsin)
W80-04153

TECHNICAL AND ECONOMIC EVALUATION OF AN MSF SOLAR ENERGY POWERED DESALINATION PLANT,
For primary bibliographic entry see Field 3A.
W80-04155

ENVIRONMENTAL ALTERNATIVES AND SOCIAL GOALS,
DuPont Co., Wilmington, DE.
For primary bibliographic entry see Field 6E.
W80-04157

REBUTTAL OF 'ECONOMIC VALUE OF NATURAL COASTAL WETLANDS: A CRITIQUE',
Georgia Univ., Athens. Inst. of Ecology.
E. P. Odum.
Coastal Zone Management Journal, Vol 5, No 3, p 231-237, March, 1979. 13 Ref.

Descriptors: *Ecosystems, *Economics, *Energy, *Market value, *Environment, *Pricing, Ecology, Wetlands, Solar energy, Energy budget, Energy flow, Decision making, Economic justification, Balance of nature, Evaluation, Land appraisals, Land use, Conservation, Land development, Resources, Management.

This article points out how the natural environment's goods and services are grossly undervalued in conventional economic accounting. Economists believe that new technology will always find substitutes for items which become scarce. This is often true for synthetic goods and services; but for land and life-support systems such as water or food no substitutes exist. Narrow economic views, that it is permissible to destroy resources such as an estuary if alternative economic activity equals or exceeds the original activity dollarwise, are challenged. The more preferable alternative is to build factories on high ground so that industry and marshes can be coupled for greater long-term economic gain. The market system fails when the monetary return on one gallon of water is much higher when used for manufacturing or mining than for agriculture or drinking. Natural life-support systems cannot be priced; people cannot live without them. Natural solar-powered ecosystems

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interface with artificially fuel-powered urban-industrial systems and fuel-subsidized agricultural systems to provide a desirable synergism. Interfaced natural ecosystems can supply one-third the total energy maintaining a city in a healthy state in terms of economic and quality-of-life dimensions. Total energy flow, as opposed to net energy output, is used as a basis for calculating the value of natural ecosystems. (Danovich-Wisconsin)
W80-04158

ON THE COST-BENEFIT ANALYSIS OF PORT PROJECTS,
University Coll. of North Wales, Bangor.
S. R. C. Wanhill.
Maritime Policy and Management, Vol 5, No 4, p 315-326, September, 1978. 2 Fig, 7 Ref, 1 Append.

Descriptors: *Investment, *Harbors, *Economics, *Benefits, *Cost-benefit analysis, Port authorities, Shipping, Navigation, Equations, Import, Export, Costs, Elasticity of demand, Elasticity of supply, Mathematical models, Mathematics, Curves, Welfare(Economics), Theoretical analysis.

Mathematical models are presented which examine whether port investment projects reduce shipping costs and which deal with both exporter and importer cases. The theoretical background to port investment projects is outlined and compared against common practices that consider benefits of port improvements as cost savings accruing to shipowners. These savings result from reductions in congestion and turnaround time in the case of improved berthing and handling facilities and reductions in congestion and shipping costs/ton cargo when channel deepening takes place, permitting larger vessel use. When calculating welfare changes, the major constraints are time and data availability. The problem involves estimating demand and supply functions for imported and exported goods and their associated elasticities. The crucial step relates to assumptions that export supply curves for trading nations other than the home country are horizontal. Assumption appeal and practical relevance clearly depends upon circumstances; however, this assumption is realistic in the case of small economies such as developing countries. (Danovich-Wisconsin)
W80-04160

OPTIMIZING THE BENEFITS OF INVESTMENTS IN SEWERAGE IN DEVELOPING COUNTRIES,
WAPORA Inc., Washington, DC.
U. P. Gibson.
Progress in Water Technology, Vol 10, No 5/6, p 1211-1216, 1978. 11 Ref.

Descriptors: *Optimization, *Economics, *Investment, *Sewerage, *Developing countries, *Environmental sanitation, Benefits, Rural areas, Sewage treatment, Public health, Sewage disposal, Social aspects, Water supply, United Nations, Water resources development, Planning, Governments, Financing, Loans, Human diseases.

Optimization techniques cannot be applied to sewerage and other forms of sanitary sewage disposal planning in developing countries. Present knowledge does not permit sewerage investment optimization. Attempts at rigorous quantification are likely to be futile, non-transferable and of questionable benefit. It is universally recognized that adequate quantities of safe water together with sewage disposal are basic necessities for good health and productivity. In 1975 only 646 million people of 33% of the total population in developing countries were adequately served by public sewers or household systems. These include only 15% rural population and 75% of the urban population. Adequate disposal facilities for human wastes are greatly significant for public health and economic development. Human excreta is the principal source of pathogenic organisms which cause many communicable diseases transmitted by water, food, and flies. The United Nations Conference on Human Settlements recommends that by 1990 all populations have community water supply and sewerage services. This target requires the following: Sewage disposal and water supply should be recognized as a basic infrastructural element and less as social services. Greater emphasis must be placed on serving needs of the rural poor. Since sewage disposal investment is greater than developing countries' resources, much greater external assistance is needed. Donor countries and international agencies should allow much greater flexibility in loan criteria by including prevailing economic and social conditions. (Danovich-Wisconsin)
W80-04163

SOME POLICY IMPLICATIONS OF WATER DEVELOPMENT,
Biswas and Associates, Ottawa (Ontario).
For primary bibliographic entry see Field 6D.
W80-04184

ENVIRONMENTAL IMPLICATIONS OF WATER DEVELOPMENT FOR DEVELOPING COUNTRIES,
For primary bibliographic entry see Field 6D.
W80-04186

OPTIMAL WATER USE AND SALINITY CONTROL FOR ENERGY--UPPER COLORADO RIVER BASIN,
Arizona Univ., Tuscon. Dept. of Soils, Water and Engineering.
For primary bibliographic entry see Field 6A.
W80-04190

BIOECONOMIC MODEL OF THE GULF OF CARPENTARIA PRAWN FISHERY,
British Columbia Univ., Vancouver. Dept. of Mathematics.
C. W. Clark, and G. P. Kirkwood.
Journal of Fisheries Research Board of Canada, Vol 36, No 11, p 1304-1312, 1979. 3 Fig, 3 Tab, 3 Ref.

Descriptors: *Fisheries, *Fish management, *Gulf of Carpentaria, Australia, *Mathematical models, *Shrimp, Commercial fishing, Australia, Model studies, Optimization, Economics, Competition, Long-term planning, Optimum development plans, Shellfish, Commercial shellfish, Fish harvest, Fishing gear.

The study presents a bioeconomic model pertaining to a recently developed prawn fishery in the Gulf of Carpentaria and adjacent waters in Northern Australia. However, the constant annual recruitment rate on which optimal long-term fleet size is based, is unrealistic. Additional biological studies concerning recruitment rates and more detailed economic surveys are needed to alleviate some of the shortcomings of the present model. The model employs 21 parameters to describe performance of two classes of vessels (brine and freezer trawlers) exploiting several stocks of prawns. The number of each vessel class entering the fishery under free access is predicted. When predictions are compared to the real situation, neither vessel type described by the model is optimal, but less expensive, smaller freezer trawlers are more appropriate. Thus many brine vessels are currently being fitted with freezing facilities, while newly constructed freezer trawlers have smaller dimensions than previous ones. Linearity of the model, which concludes that optimal allocation requires the entire fleet to be allocated to one stock at one time, is contradicted by data from the real situation. Due to such factors as crowding and interference, saturation of unloading facilities, and competition for prawn catch by individual vessels, the fleet is spread over the stocks. (Harris-Wisconsin)
W80-04199

6C. Cost Allocation, Cost Sharing, Pricing/Repayment

DYNAMIC WATER MANAGEMENT: AN OPTIMAL CONTROL APPROACH,
California Univ., Davis. Dept. of Agricultural Economics.
J. E. Noel.
Available from the National Technical Information Service, Springfield, VA 22161 as PB80-157084, Price codes: A11 in paper copy, A01 in microfiche. PhD Dissertation, January 1979, 212 p, 11 Fig, 28 Tab, 7 Appen. (California Water Resources Center Project UCAL-WRC-W-526). OWRT-B-187-CAL(2).

Descriptors: *Water management(Applied), *Computer models, *Linear programming, Economics, Optimization, California, Water supply, Water demand, Evaluation.

A dynamic water management model is used to determine the socially efficient allocation of the region's ground and surface water resources. The allocation problem is divided into three major areas: (1) spatial allocations, (2) intertemporal allocations and (3) conjunctive use allocations. The management model uses the present value of current use and present value of storage to simultaneously determine all three allocation problems. A linear programming model is formulated to provide shortrun impact analysis of the agricultural sector and to provide derived demands for agricultural water and a linear quadratic control model is used for determining the socially optimum spatial and intertemporal allocations of water over a thirty-year planning horizon. The two models interact with each other in an iterative procedure permitting overall optimization of the economic and hydrologic system. The dynamic water management model is used to analyze the impact of four different energy cost senarios on the socially optimal allocation of ground and surface water and to empirically evaluate the economic validity of taxation and pro-rata quota policies for achieving a socially optimum allocation of groundwater. (Snyder-Calif)
W80-03905

PLANNING FOR NONPOINT POLLUTION CONTROL IN NORTH CAROLINA,
Soil Conservation Service, Raleigh, NC.
For primary bibliographic entry see Field 5B.
W80-04130

LEAST COST SOLUTIONS TO THE PROBLEM OF EFFLUENT ABATEMENT IN URBAN SYSTEMS,
Commerce and Business Administration, Vancouver (British Columbia).
For primary bibliographic entry see Field 5D.
W80-04154

COST BEHAVIOR AND WATER SYSTEMS,
West Virginia Univ., Morgantown. Coll. of Business and Economics.
P. C. Mann, and J. L. Mikesell.
Water Resources Bulletin, Vol 15, No 5, p 1301-1307, October 1979. 1 Tab, 9 Ref.

Descriptors: *Water supply, *Density, *Water utilization, *Economies of scale, *Cost analysis, Water costs, Costs, Statistics, Water consumption(Except consumptive use), Utilities, Equations, Production, Distribution, Regression analysis, Water rates, Unit costs, Water demand, Water delivery.

Only scale and per-capita use significantly affect water system costs, while consumer density has little effect. Water consumers benefit from being served by large systems and being located in service areas characterized by relatively high per capita usage. Analysis provides little evidence that more dense areas have lower water service costs than less dense areas. However, the results might have been different if cost data could have been disaggregated into production and distribution components. Water service cost analyses are hindered by the lack of homogeneity across firms within the water utility industry. Relatively low coefficients of determination for equations reflect some analysis limitations. Cost variables suffer from a lack of disaggregation. Several nonquantifiable variables, such as differences in regulation, create cost differences not reflected by traditional variables. Differences in accounting procedures, financial environment, climate, terrain and hydrological conditions also affect cost differences.

Some unexplained cost variation is also attributed to internal efficiency differences across water systems. (Danovich-Wisconsin)
W80-04156

REBUTTAL OF 'ECONOMIC VALUE OF NATURAL COASTAL WETLANDS: A CRITIQUE',
Georgia Univ., Athens. Inst. of Ecology.
For primary bibliographic entry see Field 6B.
W80-04158

CAPITAL COST FUNCTIONS OF A SURFACE WATER TREATMENT PLANT AND ITS COMPONENTS,
Illinois Univ. at Urbana-Champaign. Coll. of Commerce and Business Administration.
H. Hinomoto.
Water Resources Research, Vol 13, No 6, p 873-876, December 1977. 1 Fig, 2 Tab, 8 Ref.

Descriptors: *Treatment facilities, *Capital costs, *Diseconomies of scale, Water treatment, Costs, Economics, Economies of scale, Surveys, Regression analysis, Cost analysis, Investment, Geographical regions, Sewerage, Public utilities, Waste water treatment, Water pollution control, Operating costs.

Analysis of 12 water treatment plants with 1-12 mgd capacity range constructed 1965-1972 shows diseconomies of scale in capital costs. This is contrary to investment cost functions showing economies of scale in past studies on surface water plants. Beta estimated values in past studies, including Koenig, Ackermann and Orlob and Lindorfs, were 0.67 showing economies of scale. The present study has 1.166 beta value, indicating small but positive economies of scale. Cost data includes: (1) site preparation and outside work; (2) building and structure; (3) piping, valves and gates; (4) equipment; and (5) utility work. Six plants are located in North Central U.S., four in the North Atlantic region, and two in the South Atlantic region. Although study results indicate diseconomies of scale in investment cost, plant use may actually become increasingly attractive with capacity. Both investment cost and operating cost need to be determined. Long-run technological change may affect plant design or construction procedure which may change relative magnitudes of labor, material and equipment costs constituting total costs. In particular, labor-saving devices installed for plant operation may increase plant investment cost but decrease operating cost. (Danovich-Wisconsin)
W80-04161

WATER RATE POLICY: LESSONS FROM LESS DEVELOPED COUNTRIES,
International Bank for Reconstruction and Development, Washington, DC. Dept. of Energy, Water and Telecommunications.
J. J. Warford, and D. S. Julius.
The Journal of the American Water Works Association, Vol 71, No 4, p 199-203, April, 1979. 1 Tab, 9 Ref.

Descriptors: *Water rates, *Water policy, *Developing countries, *Public utilities, *Water supply development, Urban sociology, Utilities, Water supply, Planning, Prices, Tariff, Income, Income distribution, Water demand, Long-term planning, Rates, Social aspects, Marginal costs, Economic efficiency, Economics.

Technologically advanced countries can learn about water pricing from less-developed countries (LDCs) since physical and financial constraints faced by LDCs are appearing in slightly different forms in Los Angeles and New York. More long-term planning goes into tariff setting in LDCs than in developed countries. Three factors (narrow revenue base, rapidly growing demand, and resulting necessity to explore alternative service levels) have shaped water utilities' rate-making philosophy in LDCs. Most LDCs have some type of increasing block tariff whereas in the U.S. declining block tariffs are widespread. Some water systems in LDCs are designed for consumption levels lower than 200-400 l.pdc or without sufficient pressure to meet peak demands; these are cost-saving alternatives. The widely shared concern that the poor be provided with at least minimal water service at low cost forces LDCs to include marginal cost pricing for large customers. The U.S. is experiencing problems similar to those of LDCs. Local resource base in U.S. cities is limited by growing demands of competing needs gaining approval of new bond issues which finance water and sewer expansion is increasingly difficult. Although water demand in the U.S. is not expected to grow more rapidly than in the past, the changing supply situation results in conditions similar to those in LDCs. The most effective way to encourage conservation is by pricing water used in excess of basic sanitation needs at its full marginal cost. (Danovich-Wisconsin)
W80-04162

6D. Water Demand

DYNAMIC WATER MANAGEMENT: AN OPTIMAL CONTROL APPROACH,
California Univ., Davis. Dept. of Agricultural Economics.
For primary bibliographic entry see Field 6C.
W80-03905

WATER SCARCITY AND THE POLITICS OF PLENTY IN THE FOUR CORNERS STATES,
Arizona Univ., Tucson.
H. Ingram, N. Laney, and J. R. McCain.
The Western Political Quarterly, Vol 32, No 3, September 1979. p 298-306. 9 p, 3 Tab, 21 Ref. OWRT B-056-ARIZ(3), 14-34-0001-7111.

Descriptors: *Water policy, *Water allocation(Policy), *Water supply, *Administration, Colorado, New Mexico, Arizona, Utah, Agriculture, Irrigation water, Urbanization, Colorado River Basin, Legislation.

The allocation of water resources in the fast growing arid Four Corners states of Arizona, New Mexico, Colorado, and Utah is examined. In this area demand is rapidly growing for a limited supply of water due to urban growth, energy development, and Indian tribe claims. Historically agriculture has used 80 to 90% of surface and groundwater for irrigation. While this level of consumption currently remains high the contribution of agriculture the area's economy has sharply declined. It is unlikely that supplies will be substantially increased in the future due to the near exhaustion of good dam sites and water project funding cut backs by the Carter Administration. Many economists, water lawyers, and other observers recommend reallocation of water from less to more economic uses such as away from agriculture and toward cities. Such reallocation would require State legislative action. A survey of voters and legislators showed that both groups are not readily willing to make trade-offs among users. The survey indicated that the voters desired more or the same amount of water for agriculture in the future. Senators want to give the same water to agriculture but also recognize the growing needs of other users. Voter preferences make policy options open to legislators politically difficult or infeasible which probably means that the State legislatures will not take an active role in water policy. Crucial decisions will be left to the courts, the executive, special commissions, and negotiations among interest groups or the market. (Seigler-IPA)
W80-03919

MANAGING A LIMITED RESOURCE: THE POLITICAL CONTRAINTS ON WATER POLICY IN THE FOUR-CORNERS STATES,
Arizona Univ., Tucson.
H. Ingram, N. Laney, and J. R. McCain.
The Utah Law Review, Vol 1979, No 4, p 719-745. 17 Tab, 31 Ref. OWRT B-056-ARIZ(2), 14-34-0001-7111.

Descriptors: *Water policy, *Water allocation(Policy), *Water supply, *Administration, Colorado, New Mexico, Arizona, Utah, Recreation, Agriculture, Irrigation water, Industrial water, Urbanization, Colorado River Basin, Legislation.

The opinions of State senators and voters about water allocation, water scarcity, and related water issues in the Colorado River Basin states of Arizona, Colorado, New Mexico, and Utah are examined and compared. Water policy questionnaires were mailed to a sample of 50 voters, stratified by party registration, in each State legislative district and to State senators in 1975-1976. Presently agriculture is the largest user of western water followed by municipal and industrial uses, minerals, thermal electric uses, and recreation, fish, and wildlife uses. Both senators and voters wish all users to get more water in the future or at least the same proportion of available water. The problem is that in these four states demand is increasing while the physical limits of ground and surface water have nearly been reached. Pressure for more water or reallocation will increase if urban growth continues and energy development occurs. Survey respondents declined to set priorities or to suggest tradeoffs as solutions. Such priorities might be increased water prices for urban water or increased water prices for farm water. While the voters favored more water to agriculture the senators were more sensitive to urban populations. There is little indication that legislators are willing to take either the credit or the blame for water policy decisions and it is likely that they will delegate this responsibility to others if possible. Voters appear somewhat unwilling to accept changes in water policy. This unwillingness to accept change coupled with the lack of legislative incentive make it likely that water policy in the future will be little changed from past or current water policy. (Seigler-IPA)
W80-03920

AN OPTIMAL SAMPLING PROCEDURE FOR THE COLLECTION OF RESIDENTIAL WATER USE DATA,
Johns Hopkins Univ., Baltimore, MD.
S. H. Hanke, and A. Mehrez.
Water Resources Research, Vol 15, No 6, p 1343-1348, December 1979. 1 Fig, 7 Tab, 7 Ref.

Descriptors: *Sampling, *Water users, *Data collections, *Statistics, Water supply, Water demand, Climates, Optimization, Data processing, Statistical methods, Analytical techniques, *Sampling theory, Residential water use.

Sampling theory was used to design an optimal sample of individual residential water users for the United States. The purpose of designing this optimal stratified random sample was to facilitate an efficient nationwide collection of residential water use data which can be analyzed statistically to forecast water use and to determine water system design criteria. This sample was designed in two steps: (1) the specific type and number of customers to be sampled at each location and (2) the specific locations to be sampled. (Sims-ISWS)
W80-03931

COST BEHAVIOR AND WATER SYSTEMS,
West Virginia Univ., Morgantown. Coll. of Business and Economics.
For primary bibliographic entry see Field 6C.
W80-04156

DOMESTIC WATER SUPPLIES, HEALTH AND POVERTY: A BRIEF REVIEW,
R. Feachem.
Water Supply and Management, Vol 2, No 4, p 351-362, 1978. 3 Fig, 31 Ref.

Descriptors: *Domestic water, *Public health, *Water-related diseases, *Diseases, *Water quality, *Rural areas, *Water pollution effects, Poverty, Human diseases, Social aspects, Water purification, Planning, Water supply, Epidemiology, Water quality control.

The magnitude of the world problem of providing adequate domestic water supplies for people is immense and progress at present is slow. Improved domestic water supplies hold out the hope of improved health. The fundamental prerequisite for any understanding of water supplies and health is the classification of water-related infections. These

are: (1) fecal-oral diseases; (2) water-washed diseases; (3) water-based diseases; and (4) water-related insect vector. Studies on the impact on health of domestic water supplies has revealed that there is (1) a wide-spread tendency to fail to demonstrate any marked association between water quality and diarrheal disease; (2) provision of public taps in a community may not itself change hygiene or water use patterns and may not even increase the volume of water used per capita; and (3) where the availability of water is greatly improved a marked reduction in water-related disease may be found. However, installation of improved water supply sources may lead to a reduction of water-borne transmission of the fecal-oral group of diseases without reduction of diseases in the other groups. Investigations into the impact of water supplies are often complex, costly and time consuming. There will clearly be no widespread health benefits unless a country has an efficient and effective rural water program. A major increase in the amount of evaluation work undertaken would be beneficial in promoting improvements in program planning, policy and execution. (Iervolino-NC)
W80-04183

SOME POLICY IMPLICATIONS OF WATER DEVELOPMENT,
Biswas and Associates, Ottawa (Ontario).
A. K. Biswas.
Water Supply and Management, Vol 2, No 3, p 215-226, 1978. 6 Tab, 17 Ref.

Descriptors: *Water development, *Policy, *Political aspects, *Water resources development, *Developing countries, *Decision-making, *Water supply development, Administration, Planning, Water allocation, Water utilization, Agriculture, Industry, Hydroelectric power, Social aspects, Environmental aspects, Water resources, Water management(Administrative).

More and more water will be necessary to satisfy basic human needs because of the continuing increase in world population and the rising standard of living. The quality and quantity of water required to satisfy demands vary considerably depending on type of demand, geographical locations, cultural traditions, standards of living, climatic characteristics and other individual factors. Policy options for uses of water are divided into the following major sectors: rural and urban water supply, water for agriculture, water for industry and hydroelectric power. The social and environmental impacts of water development can be best considered by dividing the effects into three categories of subsystems: physical, biological and human. The physical subsystem includes the hydrologic system, atmospheric system and crusted system. The biological subsystem includes the aquatic ecosystem and the terrestrial ecosystem. The human subsystem is divided into the production system and the sociocultural system. Integrated water management must be insured so that improvement in one sector should not take place at the cost of another. The agricultural sector, which accounts for nearly 80% of the global water consumption, is probably the most inefficient sector and is where most improvements could be made. The problem of water availability in the future is basically a problem of more rational and better management systems. (Iervolino-NC)
W80-04184

MANAGEMENT OF RURAL WATER SUPPLIES,
G. Schultzberg.
Water Supply and Management, Vol 2, No 4, p 333-340, 1978.

Descriptors: *Rural water supply, *Water supply, *Water supply development, *Developing countries, *Water resources development, Administration, Operation and maintenance, Construction, Project purposes, Regional development, Resources, Public health.

In most developing countries rural water programs have emerged from the ministries of health in their efforts to prevent water-borne and water-related diseases. In many countries these programs have remained in the health ministries but in some countries the rural program has been transferred to the urban water supply agency. In other countries rural water supply is seen as a complement to rural development programs and thus is the responsibility of agriculture ministries. Many countries do not have a national target and clearly defined policies for rural water supply development. In place of this is a project-by-project approach which is directed by what external financial and technical resources can be acquired. In the formulation of national programs the following variables are taken into account: (1) priority areas and selection of schemes; (2) level of service to be provided; and (3) participation of the potential beneficiaries and their contribution towards the program. The technology used in the program is often determined by the physical conditions and the options are limited. The choice is between a groundwater or surface-water source; groundwater is generally more reliable. Construction work is carried out with paid laborers or with the help of free self-help labor from the potential beneficiaries. Operation and maintenance problems are ever increasing and are due to under-estimated budget proposals, insufficient allocations and the lack of trained and skilled persons to do the job. Such agencies as UNICEF, WHO and the World Bank have been providing technical and financial assistance to solve these rural water supply programs. In addition to these agencies individual countries such as Sweden, Canada, USA, the Netherlands and West Germany have been making big contributions. (Iervolino-NC)
W80-04185

ENVIRONMENTAL IMPLICATIONS OF WATER DEVELOPMENT FOR DEVELOPING COUNTRIES,
A. K. Biswas.
Water Supply and Management, Vol 2, No 4, p 283-297, 1978. 3 Tab, 30 Ref.

Descriptors: *Environmental effects, *Water resources development, *Water supply development, *Planning, *Project purposes, *Public health, *Water quality, Disease, Ecology, Irrigation effects, Administration, Social aspects, Water supply, Biology, Physical properties, Human diseases, Potable water, Reservoirs.

The environmental implications of water resources development can be divided into three categories of sub-systems: physical, biological and human. The physical sub-system can be further divided into the hydrologic, atmospheric and crustal systems. Water development projects invariably change river and ecosystem regimes; therefore the issue is not whether the environment will be affected but rather how much change is acceptable to society as a whole, and what countermeasures should be taken to keep the adverse changes to a minimum, at a reasonable economic cost. The biological sub-system is divided into the aquatic ecosystem and terrestrial ecosystem. Changing the biological sub-system affects the quality and availability of potable water. This in turn either reduces or increases health hazards such as cholera, typhoid, infectious hepatitis and other water-borne diseases. Water resources developments do not only bring unmitigated benefits; they also often are responsible for unanticipated social costs. Thus in irrigation developments in tropical and semi-tropical regions a secondary effect is the spreading of parasite water-borne diseases because of the creation of favorable ecological environments for these diseases. The impacts of water developments on the human sub-system could be direct or indirect, stemming from direct effects on physical and biological sub-systems. This addition of environmental quality to the traditional objectives of water resources development of economic efficiency and regional income redistribution has made the planning process more complex than ever before. Inclusion of environmental quality as an objective recognizes the fact that the welfare of society has dimensions besides economics; the issue is how it should be incorporated objectively within the planning framework. Planners must give emphasis to the social and environmental consequences of water development projects. (Iervolino-NC)
W80-04186

THE 1976-1977 CALIFORNIA DROUGHT--A REVIEW,
California State Dept. of Water Resources, Sacramento.
For primary bibliographic entry see Field 2E.
W80-04189

6E. Water Law and Institutions

THE POLLUTION CONTROL TAX INCENTIVE: A NON-INCENTIVE,
Missouri Univ., Columbia.
L. A. Nikolai, and R. Elam.
The Accounting Review, Vol 54, No 1, p 119-131, January 1979. 2 Fig, 8 Tab, 13 Ref.

Descriptors: *Pollution taxes(Charges), *Taxes, *Economic efficiency, Certified Pollution Control Facility(CPCF) policy, Regulation, Investment, Return(Monetary), Amortization, Depreciation, Pollution abatement, Equipment, Capital costs, Economics, Government supports.

In 1976 Congress re-enacted the Certified Pollution Control Facility (CPCF) policy under the assumption that federal subsidies in the form of a significant decrease in federal taxes would serve as an incentive to stimulate pollution control investments. However, the present-value federal income tax impact model developed in this study presents substantial evidence that CPCF does not serve as an incentive. In many cases, assuming that firms operate within a 10-20% cost-of-capital range, CPCF does not yield additional present-value tax savings over and above those which would arise from the usual accelerated depreciation deduction and available investment tax credit. Only when the facility has at least a 10-12 yr life for continually profitable manufacturing firm paying no minimum tax, or at least a 14-19 yr life for a manufacturing firm paying no minimum tax, is the CPCF alternative financially attractive. Even then, on an investment of $1 million, maximum tax savings amount to less than $66,000 (or 6.6% of the investment) for profitable firms investing in a facility with a 26 year life. Tax savings are substantially less for a firm in an initial net operating loss position. In addition, due to rapidly improving technology in pollution control equipment, firms will probably prefer shorter-life facilities. Finally CPCF may not be worth the additional paperwork required to obtain certification. (Harris-Wisconsin)
W80-03968

ENVIRONMENTAL PROBLEMS OF DEVELOPING COUNTRIES,
Urban Development Inst., Bombay (India).
R. Mayur.
Annals of the American Academy of Political and Social Sciences, Vol 444, p 89-101, July 1979.

Descriptors: *Environmental control, *Pollution, *Less-developed countries, *India, *Human population, *Adoption of practices, *Social aspects, Environmental effects, Air pollution, Pollution abatement, Water pollution, Urbanization, Human pathology, Diseases, Industrial production, Long-term planning, Planning, US Environmental Protection Agency, Conservation, Forest management, Growth rates, Environment.

A growing world crisis of under-developed countries, in which uncontrolled population growth, urbanization and substandard environmental protection arrangements combine to cause incalculable social misery, is exemplified by India. That country's 635 million population, increasing at an annual 2%, will number 900 million by the end of the century. Per-capita income is $150, only 130 million metric tons of food are produced each year, and only 40% of the population get safe water for drinking and personal hygiene. India's environmental problems include pollution of air and water, cacophonious noise in the cities, and increasing land pollution through uncontrolled solid waste disposal. By the next century, one-third of the population will be living in 5,000 urban settlements and increased industrialization will have intensified environmental problems even beyond today's unthinkable levels. Immediate envi-

ronmental management steps are needed. Recommendations for action include: (1) Decentralization of population growth and industrialization through urban systems planning. (2) Industrial pollution control through government incentives to private firms in the form of financial assistance to purchase and install modern pollution control equipment. (3) Establishment of an Environmental Planning Ministry to function similar to the US Environmental Protection Agency with broad national and state powers. (4) Development of conservation and reforestation movements, including green belt developments around large cities. (5) Establishment of nationwide educational programs to foster environmental ethics. (Harris-Wisconsin)
W80-03969

LIABILITY WITHOUT FAULT UNDER THE FEDERAL WATER POLLUTION CONTROL ACT,
B. Valdez-Ferreira.
Natural Resources Journal, Vol 19, No 3, p 687-692, July 1979.

Descriptors: *Legal aspects, *Federal Water Pollution Control Act, *Oil spills, Penalties(Legal), *Judicial decisions, Legislation, Water Quality Act, Fuels, Gasoline, Tex-Tow, Inc., Marathon Pipe Line Company, Mississippi River, Kaskaskia River, Illinois, Acts of God, Law enforcement, Regulation, Coast Guard regulations.

A legal review is made of two cases heard before the Seventh Circuit Court of Appeals, in which a federal appeals judge reluctantly decided that a river barge line operator and an overland pipeline company were both responsible for civil penalties assessed by the Coast Guard for separate but major oil spills into navigable waters. In 1974, 1600 gallons of gasoline went into the Mississippi River when a tank barge operated by Tex-Tow, Inc. was punctured. The following year 19,992 gallons of crude oil were discharged into the Kaskaskia River in southern Illinois from a pipeline owned by Marathon Pipe Line Company; more than half the oil escaped downriver. Both firms were penalized under Section 1321(b)(6) of the Federal Water Pollution Control Act, by the United States District Court for the Eastern District of Illinois. The appeals court affirmed the earlier finding and held each defendant subject to the civil penalty even though the enterprises were not at fault and the spills were caused by third party acts or ommissions. These cases essentially mean that polluters may be charged with liability without causation; the courts found that substantive due process claim by the defendants had been struck down by the U. S. Supreme Court as early as 1937 (in a price control case). The judges, in summation, found that unjustified penalties such as those imposed on Marathon and Tex-Tow are eventually passed on to the consuming public, but that it is important for polluters to pay for pollution in such large-scale spills. (Harris-Wisconsin)
W80-03971

WOOD PULP, WATER POLLUTION, AND ADVERTISING,
California Univ., Los Angeles. Dept. of History.
J. G. Burke.
Technology and Culture, Vol 20, No 1, p 175-195, January 1979. 5 Tab.

Descriptors: *Pulp and paper industry, *Water pollution sources, *Advertising industry, *Social aspects, *Technology, Lumbering, Industrial wastes, Pulp wastes, Social change, History, Social needs, Social impact, Suspended solids, Industrial production, Waste water(Pollution).

The relationship between the mounting volume of printed advertising in the United States and the increasing pollution of the nation's waters is explored in a study which traces the growth of American advertising in historical context, a perspective which assumes that advertising will continue to flourish and cause increased water pollution levels. Technological progress in the late 19th century created a demand for novel and effective techniques of marketing mass-produced products, and advertising filled this demand as an optimal solution. At the same time, technology in the form of new processes for wood pulping made sufficient quantities of newsprint, paper and paperboard available at low cost to permit the advertising industry to grow and prosper. All this resulted in massive water pollution. Of 61.9 million tons of paper and paperboard produced in the US in 1973, at least 50% was used for advertising and for packaging and shipping advertised products. In 1963 the pulp and paper industry was responsible for 16.7% (3 billion lb) of settleable and suspended solids in all US industrial wastewater. Advertising is thus directly responsible for an additional large percentage. (Harris-Wisconsin)
W80-03972

CULTURAL DIFFERENCES IN PERCEPTIONS OF ENVIRONMENTAL PROBLEMS,
State Univ. of New York at Buffalo. Dept. of Political Science.
For primary bibliographic entry see Field 6B.
W80-03973

OFFENSES AGAINST THE ENVIRONMENT AND THEIR PREVENTION: AN INTERNATIONAL APPRAISAL,
G. O. W. Mueller.
Annals of the American Academy of Political and Social Science, Vol 444, p 56-66, July 1979.

Descriptors: *Air pollution, *Water pollution, *International law, *Jurisdiction, *Law enforcement, Environment, Pollutants, Legal aspects, Political aspects, Judicial decisions, United Nations, Regulation, Public rights, Governmental interrelations, Governments, Boundaries(Property).

Little effort has been made to utilize criminal sanctions of international law to control pollution, even though pollutants and their effects do not stop at jurisdictional boundaries. The International Court of Justice at the Hague, a United Nations organ, has no criminal jurisdiction and a United Nations International Criminal Court is not yet fully developed. Therefore, no effective mechanism for international criminal law exists. However, certain pollutiona offenses have become international criminal law by being subjected to universal jurisdiction under national law, such as the negligent release of nuclear energy or dumping pollutants from ships or aircraft into the Mediterranean Sea. Several problems are inherent in using international criminal sanctions in order to control internationally significant environmental pollution: qualification and quantification; strict liability; vicarious liability; corporate liability; proof; abuse of power; inadequate enforcement; changing priorities; trends toward decriminalization; and countervailing penalization policies. Significant pollution is a complicated industrial activity involving a large number of persons with ill-defined responsibilities, thus causing vicarious liability. Difficulties also arise because regulatory provisions are often complex and verbose, if not unintelligible, and therefore enforcement actions take a long time and are often ineffective. (Danovich-Wisconsin)
W80-03977

NEWFOUNDLAND'S CLAIM TO OFFSHORE MINERAL RESOURCES: AN OVERVIEW OF THE LEGAL ISSUES,
Windsor Univ. (Ontario). Faculty of Law.
J. Arvay.
Canadian Public Policy, Vol 1, p 32-44, Winter 1979. 12 Ref.

Descriptors: *Legal aspects, *Federal-state water rights conflicts, *Canada, *Newfoundland, *Continental shelf, Federal jurisdiction, State jurisdiction, Water rights, Political aspects, Ownership of beds, Seashores, Reservation doctrine, Federal government, State governments, Water policy, Natural resources, Resources development.

An overview is presented of legal issues involved in a dispute between Newfoundland Province and the federal Canadian government in regard to disposition and ownership of natural resources lying beneath the sea off Newfoundland's coast. Newfoundland's sovereignty prior to its joining the Canadian Conferenation may not be established by the Canadian Supreme Court. If so, only common law applies, subject to a possible finding that the British Imperial Crown bestowed upon Newfoundland (in its previous status as a Crown Colony) sufficient jurisdiction to establish the colony's proprietary rights over any or all adjacent offshore regions; if Newfoundland's sovereignty prior to its joining the Canadian Confederation is so established, then Newfoundland rather than Canada possesses property and jurisdictional rights. Parliament would retain right to legislate navigation, shipping, fisheries and defense. Alternatives are offered of possible ways to resolve the dispute: (1) Newfoundland would retain property rights to offshore land but plenary jurisdiction over such property would lie with Parliament. (2) The court could regard Newfoundland's pre-Confederation status as irrelevant and conclude that jurisdiction and ownership over offshore lands lies with Canada. Policy considerations rather than jurisprudence alone are likely to be most important in deciding this case. (Harris-Wisconsin)
W80-04150

ENVIRONMENTAL ALTERNATIVES AND SOCIAL GOALS,
DuPont Co., Wilmington, DE.
R. E. Heckert.
Annals of the American Academy of Political and Social Science, Vol 444, p 102-111, July, 1979.

Descriptors: *Environment, *Alternative planning, *Political constraints, *Social values, Social aspects, Political aspects, Decision making, Technology, Value, Regulation, Administration, Governmental interrelations, Institutional constraints, Standards, Costs, Benefits, Economics.

If no imminent threat to public health and safety exists, the preferred way to attain specific environmental goals is to make cost-effective improvements that are affordable, but defer other actions until technology or improved economics permit another cost-effective goal. When considering environmental alternatives, many key decisions involve social issues as much as scientific issues. Technology alone does not solve problems. Value judgements must be made and consensus politics developed if success is to be achieved. A solid consensus is needed on environmental goals. Trade-offs required to implement existing environmental programs and directives are not recognized or are regarded as inconsequential compared with benefits. The current political process involving environmental issues does not thoughtfully consider all relevant data nor allow the flexibility needed to move toward specific objectives. Overlapping responsibilities among agencies dealing with health and environmental problems lead to fragmented consideration of issues with broad impact and failure to look at the totality of regulation. Political and social scientists have an important role in this overall process. (Danovich-Wisconsin)
W80-04157

THE ECOSYSTEM APPROACH; SCOPE AND IMPLICATIONS OF AN ECOSYSTEM APPROACH TO TRANSBOUNDARY PROBLEMS IN THE GREAT LAKES BASIN.
International Joint Commission-United States and Canada, Windsor (Ontario). Great Lakes Science Advisory Board.
Special report, July 1978. 47 p, 14 Ref, 1 Append.

Descriptors: *Canada, *International commissions, *International Joint Commission, *Ecosystems, *Water pollution sources, Boundary Waters Treaty of 1909, Great Lakes Water Quality Agreement of 1972, *Great Lakes, Air pollution, Acid rain, Salts, Governments, Legislation, Water policy, Water law, Social aspects, Human population, Ecology.

An approach utilizing a man-in-a-system concept is suggested to replace the system-external-to-man concept inherent in the 1972 Great Lakes Water Quality Agreement between Canada and the United States. Incorporation of the newer approach within advisory and management functions of the two countries would necessitate political

recognition of the Great Lakes Basin as an ecosystem composed of the interacting elements of water, air, land and living organisms including human beings. Problems such as acid rain and harmful chloride concentrations could be better managed by adopting such an approach in the Great Lakes basin. Acid rain is caused by burning of fossil fuels and industrial processing; these activities add sulfur oxides and nitrogen oxides to the atmosphere. In 1970 Canada suffered an estimated $6.8 billion damages exported from the U.S. in the form of acid rain. Approximately 2.8 million metric tons of road salt per year are used in the basin for de-icing, leading to dangerous chloride concentrations in Lake Ontario. In addition, it is thought that an ecosystem approach by both countries might better control current unmanageable population growth in the Great Lakes area, which had 300,000 persons a century ago and 37 million persons today. It is recommended that the U.S. and Canada extend or amend the Boundary Waters Treaty of 1909 and the Great Lakes Water Quality Agreement of 1972 in accordance with the philosophy of ecosystem approach outlined in the paper. (Harris-Wisconsin)
W80-04159

THE CODORUS CREEK WASTEWATER MANAGEMENT STUDY, APPENDIX C. ANALYSIS OF INSTITUTIONAL ARRANGEMENTS.
Army Engineer District, Baltimore, MD.
For primary bibliographic entry see Field 5G.
W80-04178

THE BALANCE OF GROUNDWATER RESOURCES OF THE EUROPEAN COMMUNITY: A METHODOLOGY FOR A MULTINATIONAL PROBLEM,
Strasbourg-1 Univ. (France).
For primary bibliographic entry see Field 4B.
W80-04182

MANAGEMENT OF RURAL WATER SUPPLIES,
For primary bibliographic entry see Field 6D.
W80-04185

INTERACTIVE POLLUTANTS AND JOINT ABATEMENT COSTS: ACHIEVING WATER QUALITY STANDARDS WITH EFFLUENT CHARGES,
Newcastle-upon-Tyne Univ. (England). Dept. of Economics.
For primary bibliographic entry see Field 5G.
W80-04187

WEST EUROPEAN INSTITUTIONAL ARRANGEMENTS FOR ENVIRONMENTAL POLICY IMPLEMENTATION-ESPECIALLY AIR AND WATER POLLUTION CONTROL,
Akron Univ., OH. Dept. of Urban Studies.
W. R. Mangun.
Environmental Conservation, Vol 6, No 3, p 201-211, Autumn 1979. 32 Ref.

Descriptors: *West Europe, *Policy, *Governments, *Organizations, *Environmental control, Environment, Water pollution, Water pollution control, Air pollution, Institutions, Political aspects, Legislation, Regulation, Law enforcement, Institutional constraints, United Kingdom, Belgium, Denmark, Italy, The Netherlands, West Germany, France, Norway, Sweden, Switzerland.

Basic environmental policy stances, institutional arrangements and implementation approaches of several West European countries are examined. Enactment of new pollution control legislation, accelerated institutional innovation and agency reorganization throughout West European countries in the 1960s and 1970s led to an ever-increasing enforcement burden. However, no solution common to all countries tackles this problem. Some countries created new and independent agencies such as the United Kingdom's Department of the Environment. Other countries simply reorganized existing agencies. This pattern developed with the Ministry of the Interior in West Germany and in the Ministry of Public Health and Environmental Hygiene in the Netherlands. Other countries, such as Italy, did not substantially alter their organizational structure to deal with environmental problems. Pollution control approaches varied significantly. Some countries, such as Sweden, adopted comprehensive pollution-control policies which cover all basic areas: air, water and land. Other countries, such as the United Kingdom and West Germany, developed vigorous air pollution control policies while France developed strong water pollution control. In most countries, policy development was incremental, with expansion and improvement of basic pollution control laws. Countries examined were: United Kingdom, West Germany, The Netherlands, Italy, France, Norway, Sweden, Switzerland, Belgium, and Denmark. (Danovich-Wisconsin)
W80-04200

7. RESOURCES DATA

7A. Network Design

DESIGN OF OPERATIONAL PRECIPITATION AND STREAMFLOW NETWORKS FOR RIVER FORECASTING,
GKY and Associates, Inc., Alexandria, VA.
R. U. Jettmar, G. K. Young, R. K. Farnsworth, and J. C. Schaake, Jr.
Water Resources Research, Vol 15, No 6, p 1823-1832, December 1979. 7 Fig, 8 Ref.

Descriptors: *River forecasting, *Network design, *Precipitation(Atmospheric), *Streamflow, *Pennsylvania, Model studies, Hydrograph analysis, Gaging stations, Watersheds(Basins), Operations, River basins, Methodology, Mathematical models, Networks, Time lag, Hydrographs, *Susquehanna River Basin(PA), Gage density.

A methodology is presented for assessing the value of river forecasting to possible changes in existing precipitation and streamflow networks. This study was undertaken as a part of an effort to evaluate the expected benefit of automating all or part of the data-gathering networks used by the National Weather Service. A surrogate measure of benefits, called the 'mean forecast lead time,' is related indirectly to benefits because the value of river forecasting depends on the lead time available for the flood plain dweller to take action and respond to the forecast. Presented was the rationale for the methodology and the results of part of the research using streamflow generated by Hurricane Agnes (June 1972) and Hurricane Eloise (September 1975) for the Susquehanna River basin. The methodology can be used to analyze the issues of network design including gage density, automation, gage down time, network timing relationships, effects of rain forecasts, and model and other sources of error. The method can be used to evaluate existing networks. Given network and modeling automation, the method can be used to automatically select the network response time. It was recommended: A more detailed analysis and investigation of the Susquehanna data base should be undertaken. The linkage to benefits should be extended and pinned down with an objective of direct benefit estimates being generated as functions of network design parameters. The methodology should be generalized to the current generation of state-of-the-art conceptual rainfall-runoff models being introduced within NWS. An analysis should be conducted with the methodology on sufficiently general data sets to enable the generation of network design guidelines and criteria. (Humphreys-ISWS)
W80-03939

SAMPLING OF INTERRELATED RANDOM FIELDS: THE RAINFALL-RUNOFF CASE,
Massachusetts Inst. of Tech., Cambridge. Dept. of Civil Engineering.
R. L. Bras.
Water Resources Research, Vol 15, No 6, p 1767-1780, December 1979. 16 Fig, 2 Tab, 18 Ref.

Descriptors: *Hydrology, *Sampling, *Stochastic processes, *Network design, Reviews, Model studies, Forecasting, Hydrograph analysis, Mathematical models, Rainfall, Discharge(Water), Runoff, Watersheds(Basins), Rainfall disposition, Streamflow, Flood forecasting, Networks, Peak discharge, Gage density.

The rainfall-runoff process is the most common vector-valued random field studied by hydrologists. A historical review of four articles dealing with the sampling of this multivariate problem is presented. Ideas on new formulations to study the sampling needs for rainfall-runoff modeling are given. The main goal was to illustrate the development of ideas from a deterministic, linear frequency domain approach to a nonstationary, nonlinear treatment of random fields. The state of the art is encouraging, but a lot remains to be done. Areas of needed theoretical improvements are identified, and ideas on future approaches suggested. (Humphreys-ISWS)
W80-03940

CONSIDERATIONS FOR THE DESIGN OF A HYDROLOGIC DATA NETWORK USING MULTIVARIATE SENSORS,
National Weather Service, Fort Worth, TX. Southern Region.
K. C. Crawford.
Water Resources Research, Vol 15, No 6, p 1752-1762, December 1979. 5 Fig, 2 Tab, 34 Ref, 1 Append. BOR 6-07-DR-20050.

Descriptors: *Network design, *Hydrologic data, *Model studies, *Sampling, Rainfall, Mathematical models, Statistical models, Meteorological data, Rain gages, Stations, Networks, Statistical methods, Spatial distribution, Temporal distribution, Analytical techniques, Algorithms, Sensor location, Gage density.

An experimental design model has been developed to evaluate trade-offs involved in the optimal sampling of surface rainfall. The model reveals that deployment of statistically adequate sensor arrays depends critically on the storm physics, the sensor engineering aspects, and the procedure chosen for analysis of information from the deployed network. The model was used to examine the effect of sensor density reduction on the ability of a sampling system to detect signal variation. Predictand-related sensors were shown to be essential to network design. Options in multivariate sensor deployments (spatial and temporal) are explained. Deployment along and across a preferred storm track is related to convective system anisotropy, rain gage density, temporal sampling intervals, availability of radar data, and interrelationships among the multivariate predictor data sets. Any proposed sensor array was shown to represent a balance between the demands of economy and climatology. A maximum of 10 gage sensors within the coherent convective storm area is sufficient to fully explain and sample the significant signal variance of a representative High Plains convective system. A reasonably accurate surface rainfall analysis is possible using gage sensors spaced 60 sq km/gage. An equivalent analysis is obtained from good radar data and a gage density of 190 sq km/gage. Analysis accuracy in the gage network is improved only 10% when the gage density is increased to 50 sq km/gage. Quality radar data combined with gage information spaced 50 sq km apart produce 65% less sampling error variance than observed in the best sampling from gage information alone. (Humphreys-ISWS)
W80-03941

STATISTICAL CONSIDERATIONS IN NETWORK DESIGN,
Stanford Univ., CA.
P. Switzer.
Water Resources Research, Vol 15, No 6, p 1712-1716, December 1979. 2 Fig, 1 Tab, 4 Ref.

Descriptors: *Network design, *Statistical methods, *Stations, Mathematical studies, Systems analysis, Spatial distribution, Variability, Monitoring, Analytical techniques, Statistics, Error calculations.

After discussing general considerations on the importance and unimportance of optimization in spa-

tial network design, the author indicated how one might exploit spatial autocorrelations and covariate information. It was pointed out that spatial autocorrelations themselves require care in their estimation. Two illustrations showed how probabilistic error calculations are made for mapping problems using network station data. One illustration used a quantitative mapping variable, and the other used a qualitative mapping variable. (Humphreys-ISWS)
W80-03942

DENSE NETWORKS TO MEASURE CONVECTIVE RAINFALL IN THE SOUTHWESTERN UNITED STATES,
Science and Education Administration, Tucson, AZ. Southwest Rangeland Watershed Research Center.
H. B. Osborn, K. G. Renard, and J. R. Simanton.
Water Resources Research, Vol 15, No 6, p 1701-1711, December 1979. 11 Fig, 4 Tab, 13 Ref.

Descriptors: *Networks, *Rainfall disposition, *Demonstration watersheds, *Arizona, *New Mexico, Sampling, Rain gages, Watersheds(Basins), Hydrologic data, Areal, Measurement, Spatial distribution, Rainfall, Thunderstorms, Analysis, Analytical techniques, Depth-area curves, Distribution patterns, Isohyets, Correlation analysis, Runoff, *Walnut Gulch(AZ), *Alamogordo Creek(NM), Dense networks, Rain gage networks.

Almost all rangeland runoff in the southwestern United States results from intense short duration rainfall of limited area extent. In 1953, two southwest rangeland watersheds, the 150-sq km Walnut Gulch and 174-sq km Alamogordo Creek watersheds, were selected as outdoor laboratories to measure water yield from rangeland watersheds. The networks were planned initially with gages on a 1-mi grid, but difficulties in access resulted in more uneven networks, and the basic networks were not completed until 1961. Gages were added after 1961, both for better estimates of rainfall on very small intensive study areas and to fill 'gaps' in the original network. Summer storms in eastern New Mexico where frontal convective thunderstorms occur can have greater areal extent and point rainfall maximums. The simple correlation for total thunderstorm rainfall between pairs of gages decreases very rapidly with increasing distance between the gages. On the basis of the Walnut Gulch and Alamogordo Creek data, for r = 0.4 the gages could be 5 and 10 km apart, respectively. For a simple correlation of 0.9 the gages should be 0.9 and 1.3 km apart, respectively, suggesting rain gage networks of 230 and 100 gages, respectively. Gage networks that differentiate from the hypothetical network can lead to serious overestimates or underestimates of the rainfall volume for a given watershed. The isohyetal maps constructed using different networks illustrated the magnitude of the difference at Walnut Gulch. For air mass thunderstorms, relatively closely spaced gages (about 6 km, r = 0.2, on Walnut Gulch) can be assumed to be independent sampling points for determining recurrence intervals of extreme values. Estimates of the rainfall energy factor R of the universal soil loss equation (USLE) require closer spacing of the gages than does a rainfall estimate alone. Thus for erosion research on small watersheds (10 ha or less) the gage should be within or very near the area. (Humphreys-ISWS)
W80-03943

DEVELOPMENT OF HYDROMETRIC NETWORKS IN BRITISH COLUMBIA,
Water Survey of Canada, Vancouver (British Columbia).
W. L. Kreuder.
Water Resources Research, Vol 15, No 6, p 1677-1686, December 1979. 5 Fig, 3 Tab, 13 Ref.

Descriptors: *Networks, *Hydrologic data, *Canada, *Network design, Stream gages, Gaging stations, Regional analysis, Streamflow, Hydrology, Drainage area, Data collections, Sampling, *British Columbia.

The growth and purposes of the Water Survey of Canada's British Columbia network were described from a practical point of view, tracing the progress toward a rational data gathering system. The network consists of several subnetworks of which three, the regional, the major stream, and the national inventory, were described in detail. As the major stream and national networks are reasonably simple in purpose and operation, the major part of the discussion was concerned with the regional network whose main purpose is the transfer of information. To meet this purpose and to analyze the performance of the network, certain procedures for the organization of data have been employed. These procedures included data banks for both hydrologic quantities and grid square extracted physiographic characteristics and regression analysis for relating the quantities in these data banks. The discussion outlined the British Columbia experience of sampling and transferring data in a diverse and primarily mountainous terrain. (Humphreys-ISWS)
W80-03944

MEASUREMENTS OF RAINFALL INTENSITY, INSTRUMENTATION AND DATA PROCESSING,
Forsvarets Forskningsanstalt FOA, Stockholm (Sweden).
For primary bibliographic entry see Field 2B.
W80-04028

DIMENSIONALITY PROBLEMS IN WATER QUALITY NETWORK DESIGN,
Washington Univ., Seattle. Dept. of Civil Engineering.
D. P. Lettenmaier.
Water Resources Research, Vol 15, No 6, p 1692-1700, December 1979. 35 Ref.

Descriptors: *Water quality, *Network design, *Sampling, *Methodology, Reviews, Networks, Analytical techniques, Variability, Design, Stochastic processes, Statistical methods, Monitoring, Time series analysis, Kriging, State estimate theory.

Dimensionality problems in design of water quality networks arise from the multiple variables measured, which may be generated by different physical, chemical, and biological processes, and from the multiple spatial and temporal dimensions of the processes generating the measurements. The problem is further complicated by the range of objectives which a network may be required to meet. The designer is almost inevitably constrained by budget considerations to employ the same network to measure an array of variables, often for more than one objective. These considerations serve to pose serious difficulties in arriving at an analytical formulation of the problem, far less to solve it, with the result that almost all existing water quality networks have been designed on an ad hoc basis. Although no one approach is likely to be universally applicable, several techniques have been employed in particular situations. Included are state estimation, time series analysis, probability theory, and the theory of regionalized variables. Several promising applications of these techniques to water quality network design were reviewed. Few of the approaches reviewed, however, are amenable in present form to solution of practical multivariate design problems. What is needed now is a regrouping, with a closer eye toward applications, especially in light of the multidimensional nature of the network design problems faced in meeting the needs of water quality data users. (Humphreys-ISWS)
W80-04041

WATER QUALITY SAMPLING: SOME STATISTICAL CONSIDERATIONS,
Johns Hopkins Univ., Baltimore, MD. Dept. of Mathematical Sciences.
A. M. Liebetrau.
Water Resources Research, Vol 15, No 6, p 1717-1725, December 1979. 10 Fig, 1 Tab, 30 Ref. USGS 14-08-0001-G-432.

Descriptors: *Water quality, *Sampling, *Network design, *Maryland, *Watersheds(Basins), Monitoring, Statistical methods, Statistical models, Analytical techniques, Stations, Networks, Biochemical oxygen demand, Dissolved oxygen, Variability, Probability, Analysis, Mathematical models, *John Falls(MD), Sequential methods.

Typically, a state, regional, or national water quality (WQ) monitoring system has many objectives. Examples include (1) providing a systemwide synopsis of WQ; (2) determining whether selected WQ parameters show gradual changes over time; (3a) detecting actual or potential WQ problems, (3b) determining the specific causes of actual problems, and (3c) assessing the effect of any corrective action; and (4) enforcing the law. While these purposes have different data requirements, they are interrelated, and data collected for any one can have value for others; for example, data collected for the listed reasons could be used for future long-range planning. Each objective makes certain demands of a WQ sampling network, and these in turn have implications concerning sampling design and statistical analysis of resulting data. In a sampling scheme flexible enough to encompass multiple objectives, data sets collected for answering questions arising under points 1-4 need not all have similar characteristics; consequently, a variety of statistical methods are needed. A good sampling design is important for achieving the first two objectives. A working definition of 'water quality' was given initially, and this was followed by the definition of a sampling population. The set of all segments of the drainage network serves as the population for several sampling plans. In particular, the use of probability sampling to design a network of synoptic sampling stations was discussed in detail. Finally, sequential statistical procedures were applied to a specific problem of type 3c. In terms of the amount of data required, sequential methods are quite efficient for detecting changes of a specified magnitude in some WQ parameter. (Humphreys-ISWS)
W80-04042

THE WORTH OF HYDROLOGIC DATA,
Dames and Moore, Washington, DC.
D. R. Dawdy.
Water Resources Research, Vol 15, No 6, p 1726-1732, December 1979. 1 Fig, 1 Tab, 39 Ref.

Descriptors: *Hydrologic data, *Network design, *Value, Decision making, Streamflow, Precipitation(Atmospheric), Variability, Economics, Stochastic processes, Costs, Sampling, Networks, Stations.

The collection of data implies a use and a worth for those data. The first data to be collected usually contain the most information and have the most worth. As more data are collected, their marginal worth decreases, whereas their marginal cost usually does not do so, or at least not to the same extent. Therefore an optimal network design would have the configuration which either (1) has the maximum worth for a given budget or (2) has a design such that the marginal worth of data is equal to its marginal cost. In principle, the optimal design is thus conceptually simple. However, in practice, the cost of data is obtainable, though usually with some difficulty and uncertainty. Worth, in economic terms, is much more difficult to assess. Optimal design of data networks requires a measure of the worth of data. Worth is use specific and difficult to measure. Surrogates to worth, usually some measure of accuracy, have been developed. These surrogates and attempts to translate them to economic measures are discussed. Advances toward realism make solutions more difficult. Simplicity of solution and ease of understanding are required if methods developed are to have any impact on decision makers. (Humphreys-ISWS)
W80-04043

THE WORTH OF HYDROLOGIC DATA FOR NONOPTIMAL DECISION MAKING,
Arizona Univ., Tucson. Dept. of Hydrology and Water Resources.
For primary bibliographic entry see Field 6B.
W80-04044

NETWORK DESIGN USING OPTIMAL ESTIMATION PROCEDURES,
Institute of Hydrology, Wallingford (England).
D. A. Jones, R. J. Gurney, and P. E. O'Connell.
Water Resources Research, Vol 15, No 6, p 1801-1812, December 1979. 6 Fig, 1 Tab, 11 Ref.

Descriptors: *Network design, *Rainfall, *Mathematical models, *Sampling, Networks, Stations, Rain gages, Model studies, Mathematical studies, Statistical methods, Analytical techniques, Rainfall disposition, Estimating, Optimization, Correlation analysis, Theoretical analysis, Gaging stations, Areal, Error estimation.

A network of rain gages provides information about rainfall at only a limited number of points within a region: some procedure must then be adopted to estimate the rainfall for other chosen points and areas within the region. Methods were presented whereby the accuracy of rainfall estimates can be quantified so that a comparison with the requirements of users of rainfall data can be made. The calculation of the accuracy of optimal estimates based on any number and configuration of gages was described. The results can be applied to the redesign of existing networks of gages by mapping the root mean square error of point interpolation, allowing the identification of those areas where new gage sites are most needed to meet some specified criterion of accuracy. Formulae were also presented which allow the accuracy of an optimal estimate of areal rainfall to be calculated for any shape of area and any configuration of gages. (Humphreys-ISWS)
W80-04045

A CASE STUDY OF RATIONALIZATION OF A RAIN GAGE NETWORK IN SOUTHWEST ENGLAND,
Institute of Hydrology, Wallingford (England).
For primary bibliographic entry see Field 2B.
W80-04046

KRIGING IN THE DESIGN OF STREAMFLOW SAMPLING NETWORKS,
Institut National de la Recherche Scientifique, Rimouski (Quebec).
J-P. Villeneuve, G. Morin, B. Bobee, D. Leblanc, and J-P. Delhomme.
Water Resources Research, Vol 15, No 6, p 1833-1840, December 1979. 3 Fig, 4 Tab, 11 Ref.

Descriptors: *Sampling, *Streamflow, *Network design, *Model studies, Mathematical models, Analytical techniques, Statistical methods, Discharge(Water), Data processing, Stochastic processes, Gaging stations, Estimating, Optimization, Variability, Spatial distribution, Frequency, Ungaged sites.

Kriging is of particular interest in network design because of its ability to estimate streamflow values using existing stations. Another possibility offered by kriging is the estimation of variance reduction gained by addition of fictitious stations in regions of high variance. A brief description was given of kriging theory as developed at the Ecole des Mines de Paris. In order to improve and optimize the Quebec streamflow recording network design the authors kriged specific streamflows with a given return period over the Quebec province, using the data observed at existing stations. For the evaluation of the given return period flow and its sampling variance at each gaged site the authors used the log Pearson type 3 distribution model. Kriging is an optimal estimation technique, in terms of minimum variance, and contrary to other methods it gives an estimation variance for any point in the kriged domain, which is essential in network design. Network analysis and optimization are presently expensive and time-consuming undertakings. In this study of flows with given return periods, the authors demonstrated the aptitude of kriging to transpose information from gaged to ungaged sites and showed how the different elements of kriging can be used for network design. (Humphreys-ISWS)
W80-04047

USE OF PRINCIPAL COMPONENT ANALYSIS TO IDENTIFY HOMOGENEOUS PRECIPITATION STATIONS FOR OPTIMAL INTERPOLATION,
Institut National de la Recherche Scientifique, Rimouski (Quebec).
G. Morin, J. P. Fortin, W. Sochanska, J. P. Lardeau, and R. Charbonneau.
Water Resources Research, Vol 15, No 6, p 1841-1850, December 1979. 10 Fig, 4 Tab, 10 Ref.

Descriptors: *Precipitation(Atmospheric), *Networks, *Stations, *Watersheds(Basins), Analytical techniques, Optimization, Spatial distribution, Correlation analysis, Theoretical analysis, Data processing, Statistical methods, Seasonal, Winter, Spring, Summer, Autumn, Homogeneity, Sampling, Canada, *Eaton River(Quebec), Interpolation, Principal components.

The Eaton River precipitation network was set up as one of the Quebec International Hydrologic Decade projects in 1965. At the end of the decade, in 1975, 30 stations had been in operation for most of the period in this 248-sq mi basin. After a principal components analysis of the data from 14 of the 30 stations on 10-day precipitation totals, it was found that the stations could be divided into three groups, the composition and geographic distribution of which change from season to season. It was also possible to identify which stations were redundant and could be closed should it become necessary. Application of optimal interpolation, season by season, to a 30- and a 5-station network showed that the precision of point interpolation varies more from season to season for the same network than from the 30- to the 5-station network for the same season. In fact, errors of interpolation caused by microclimatic irregularities and by observational errors in the initial data are greater than those resulting from the reduction of the network from 30 to 5 stations. (Humphreys-ISWS)
W80-04048

TERMINATION OF HYDROLOGIC DATA COLLECTION (A CASE STUDY),
Science and Education Administration, Tucson, AZ. Southwest Rangeland Watershed Research Center.
For primary bibliographic entry see Field 6B.
W80-04049

A STATISTICAL APPROACH TO STATION DISCONTINUANCE,
Princeton Univ., NJ. Dept. of Civil Engineering.
For primary bibliographic entry see Field 2E.
W80-04050

7B. Data Acquisition

NON-POINT SOURCE SEDIMENTATION STUDIES USING INFRARED REMOTE SENSING,
Maine Univ. at Orono.
For primary bibliographic entry see Field 5B.
W80-03923

RAINFALL MEASUREMENTS BY WEATHER RADAR: APPLICATIONS TO HYDROLOGY,
Research Council of Alberta, Edmonton. Atmospheric Science Div.
B. L. Barge, R. G. Humphries, S. J. Mah, and W. K. Kuhnke.
Water Resources Research, Vol 15, No 6, p 1380-1386, December 1979, 10 Fig, 21 Ref.

Descriptors: *Radar, *Flood forecasting, *Rainfall, Weather, Precipitation(Atmospheric), Rain, Hydrology, Rain gages, Areal, Data storage and retrieval, *Weather radar, *Rainfall measurements, *Alberta(Canada), Surface precipitation, Data management, Digital radar, Backscatter, Areal rainfall.

Surface precipitation measurements were improved by using both weather radar and conventional rain and snow gages. Advances in digital radar data management made possible improved precipitation estimates for hydrological applications such as flood forecasting. A project undertaken in Alberta provided areal precipitation data for operational flood forecasting. Maps depicting rainfall intensities were generated at specified time intervals from the Alberta Research Council's S band weather radar. Transmitted 150 km by telecopier to the Flow Forecasting Branch, Alberta Environment, the real-time radar-derived areal maps of precipitation were used with point surface observations to specify more precisely the precipitation events that led to floods. During precipitation events, weather radar data provided an indication of the applicability of point surface observations, which led to better operational flow forecasts. Radar measurements of rainfall intensity and rainfall amount were found to be of considerable benefit to operational and applied hydrologists. (Roberts-ISWS)
W80-03929

A STOCHASTIC DESCRIPTION OF WET AND DRY SPELLS IN TERMS OF AN EFFECTIVE NUMBER OF DAYS,
Royal Netherlands Meteorological Inst., De Bilt.
For primary bibliographic entry see Field 6A.
W80-03938

MULTIDATE LANDSAT LAKE QUALITY MONITORING PROGRAM,
Wisconsin Univ., Madison.
L. T. Fisher, F. L. Scarpace, and R. G. Thomsen.
Photogrammetric Engineering and Remote Sensing, Vol 45, No 4, p 519-527, April 1979. 6 Fig, 2 Tab, 7 Ref.

Descriptors: *Lakes, *Data storage and retrieval, *Remote sensing, *Water quality, *Trophic level, Wisconsin, Data collections, Satellites(Artificial), Mapping, Data processing, Data transmission, Computer programs, Landsat, Eutrophication, Monitoring, Navigation, Computers.

A remote sensing program by Earth satellite (Landsat) is described in which multidate scanning procedures are used to monitor water quality parameters and classify approximately 3,000 Wisconsin lakes larger than 20 acres. To cope with the major data collection problems involved in a process of this scope, unified files and programs were developed to automate and systematize data handling. Three files are described: One is a link-listed file structured to permit considerable processing versatility, containing latitude-longitude based polygons which delimit each lake. A second file is built up gradually as many Landsat scenes are processed, and allows storage of extracted data. A third file contains control point coordinates from throughout the state. Software consists of three programs. The first locates control points so that satellite coordinates can be measured for scene navigation. A second program produces navigation constants. A third locates all lakes covered by a Landsat scene and extracts data for storage in a statistical summary. Use of Landsat data means that ground coordinates can help identify irregularly shaped areas which can be repeatedly accessed. The method allows exploitation of Landsat's repeated coverage. (Harris-Wisconsin)
W80-04118

MARS - A NEW INSTRUMENT FOR MEASURING PHYTOPLANKTON SINKING RATE,
Oceanic Inst., Waimanalo, HI.
G. N. Rothwell, and P. K. Bienfang.
Marine Technology Society Journal, Vol 12, No 5, p 13-17, October-November 1978. 7 Fig, 5 Ref.

Descriptors: *Phytoplankton, *Settling velocity, *Instrumentation, Equipment, Depth, Sinks, Population, Measurement, Cytological studies, Tracers, Tagging, Radioisotopes, Movement, Eutrophication.

The MARS (Multichannel Assembly for Radioplankton Sinking) technique is based on detection of the radioactive isotope C-14 which is assimilated by cells during a procedure used to determine production rates. Phytoplankton are radioactively labeled by adding C-14-bicarbonate to seawater

samples and allowing cells to take up C-14 by photosynthesis during an incubation period. After incubation, a subsample is placed as a discrete layer upon the surface of a seawater column. Labeled cells sink to the bottom, while the C-14 solution remains in the surface sample. Labeled cells are detected by Geiger-Muller systems and the phytoplankton's sinking rate is calculated. A MARS apparatus consists of a teleprinter, gas flow meter, high voltage power supply, micro-processor controller, gas supply, GM chamber chassis, motorized syringe and gimbal frame for damping ship motions. A typical time-course distribution from a sinking rate trial shows background counts; positive slope area marking arrival of labeled cells; and a plateau region reflecting decreased arrival rates when all but the slowest-sinking cells have reached the bottom. The mean cell population sinking rate is then calculated by an equation based upon numerical integration of the population arrival rate. The MARS system has been operated during two ocean cruises and has been extensively used in laboratories; trials produce reliable sinking rate measurements. (Danovich-Wisconsin)
W80-04142

7C. Evaluation, Processing and Publication

WATER RESOURCE USES AND ISSUES IN TEXAS,
Texas Agricultural Experiment Station, College Station.
J. G. McNeely, and R. D. Lacewell.
Report B-1189, August 1978. 52 p, 4 Fig, 6 Tab, 61 Ref, 12 Photos.

Descriptors: *Texas, *Water resources, *Management, *Surface waters, *Groundwater, Planning, Water utilization, Water management(Applied), Aquifers, Droughts, Water quality, Water conservation, Agriculture, Estuaries, Reservoirs, Water yield, Industrial water, Municipal water, Water policy, *Ogallala Aquifer(TX), *Gulf Coast Aquifer(TX), *Edwards Aquifer(TX).

The purpose of this report was twofold--to review the current status of water resources in Texas relative to institutions and incidence of availability and use and to address some important water resource issues facing the state. Water resources to meet agricultural, municipal, industrial, and residential demands are taken from groundwater and surface water sources. Texas has a long-term annual availability of fresh water from ground and surface sources combined of at least 14.1 million acre-feet (maf). This includes a safe groundwater yield of 5.1 maf, defined as the quantity of average, annual recoverable recharge to groundwater aquifers. It also includes a firm surface water yield of at least 9.0 maf, defined as 'the quantity of water that can be withdrawn or released from reservoirs continuously, on an annual basis, over periods of time of sufficient length so as to span the most severe period of drought in the reservoir catchment areas.' Annual groundwater overdraft is lowering water tables, increasing pumping costs, and affecting the physical characteristics of individual aquifers. A landowner in Texas owns the groundwater beneath his land and has the right to drill wells and appropriate all of the underground percolating waters generally without regard to the effect upon other landowners. Two basic doctrines of surface water rights recognized in Texas are the riparian doctrine and the appropriation doctrine. The Texas Gulf Coast has ten estuarine systems scattered from Louisiana to Mexico. The legislature is expected to make some basic policy decisions concerning the estuarine resources. Agriculture, in contrast to manufacturing and most other uses, consumes a large part of its water withdrawals. The development of Texas has exacted a high price in the deteriorating quality of its water resources. Rivers, lakes, and coastal waters have been heavily damaged by the discharge of waste, by polluted runoff from urban, agricultural, and resource development, and by accelerated erosion and sedimentation. A strategy to achieve cleaner waters and reduce the production of unnecessary pollutants is now under way. (Humphreys-ISWS)
W80-03933

WATER RESOURCES DATA FOR OKLAHOMA, WATER YEAR 1978--VOLUME 1. ARKANSAS RIVER BASIN.
Geological Survey, Oklahoma City, OK. Water Resources Div.
Available from the National Technical Information Service, Springfield, VA 22161 as PB80-143829, Price codes: A23 in paper copy, A01 in microfiche. Geological Survey Water-Data Report OK-78-1, September 1979. 523 p, 8 Fig.

Descriptors: *Oklahoma, *Hydrologic data, *Surface waters, *Groundwater, *Water quality, Gaging stations, Streamflow, Flow rates, Sediment transport, Water analysis, Water temperature, Chemical analysis, Lakes, Reservoirs, Water wells, Water levels, Data collections, Sites, *Arkansas River basin.

Water resources data for the 1978 water year for Oklahoma consist of records of stage, discharge, and water quality of streams; stage, contents, and water quality of lakes or reservoirs. Volumes 1 and 2 of this report contain discharge records for 120 gaging stations; stage and contents for 27 lakes or reservoirs; water quality for 121 gaging stations, 3 lakes, and 76 wells; and water levels for 48 wells. Also included are 42 crest-stage partial-record stations. Additional water data were collected at various sites, not part of the systematic data-collection program, and are published as miscellaneous measurements. These data represent that part of the National Water Data System operated by the U.S. Geological Survey and cooperating State and Federal agencies in Oklahoma. (Kosco-USGS)
W80-04083

WATER RESOURCES DATA FOR OKLAHOMA, WATER YEAR 1978--VOLUME 2. RED RIVER BASIN.
Geological Survey, Oklahoma City, OK. Water Resources Div.
Available from the National Technical Information Service, Springfield, VA 22161 as PB80-143001, Price codes: A12 in paper copy, A01 in microfiche. Geological Survey Water-Data Report OK-78-2, September 1979. 249 p, 8 Fig.

Descriptors: *Oklahoma, *Hydrologic data, *Surface waters, *Groundwater, *Water quality, Gaging stations, Streamflow, Flow rates, Sediment transport, Water analysis, Water temperature, Chemical analysis, Lakes, Reservoirs, Water wells, Water levels, Data collections, Sites, *Red River basin(Okla).

Water resources data for the 1978 water year for Oklahoma consist of records of stage, discharge, and water quality of streams; stage, contents, and water quality of lakes or reservoirs. Volumes 1 and 2 of this report contain discharge records for 120 gaging stations; stage and contents for 27 lakes or reservoirs; water quality for 121 gaging stations, 3 lakes, and 76 wells; and water levels for 48 wells. Also included are 42 crest-stage partial-record stations. Additional water data were collected at various sites, not part of the systematic data-collection program, and are published as miscellaneous measurements. These data represent that part of the National Water Data System operated by the U.S. Geological Survey and cooperating State and Federal agencies in Oklahoma. (Kosco-USGS)
W80-04084

WATER RESOURCES DATA FOR NORTH DAKOTA, WATER YEAR 1978.
Geological Survey, Bismarck, ND. Water Resources Div.
Available from the National Technical Information Service, Springfield, VA 22161 as PB80-126253, Price codes: A99 in paper copy, A01 in microfiche. Geological Survey Water-Data Report ND-78-1, September 1979. 774 p, 6 Fig.

Descriptors: *North Dakota, *Hydrologic data, *Surface waters, Groundwater, *Water quality, Gaging stations, Streamflow, Flow rates, Sediment transport, Water analysis, Water temperature, Chemical analysis, Lakes, Reservoirs, Water wells, Water levels, Data collections, Sites.

Water resources data for the 1978 water year for North Dakota consist of records of stage, discharge, and water quality of streams; stage, contents, and water quality of lakes and reservoirs; and water levels and water quality of ground water. This report contains discharge records for 153 gaging stations; stage only records for 16 gaging stations; stage and contents for 12 lakes and reservoirs; water quality for 76 gaging stations, 12 partial-record stations, 25 lakes, 97 wells, and water levels for 32 observation wells. Additional water data were collected at various sites, not involved in the systematic data-collection program, and are published as miscellaneous measurements. These data represent that part of the National Water Data System operated by the U.S. Geological Survey and cooperating State and Federal agencies in North Dakota. (Kosco-USGS)
W80-04085

HYDROLOGIC DATA FROM SELECTED WELLS IN THE HELENA VALLEY, LEWIS AND CLARK COUNTY, MONTANA,
Geological Survey, Helena, MT. Water Resources Div.
For primary bibliographic entry see Field 2F.
W80-04090

WATER-QUALITY ASSESSMENT OF RATTLESNAKE CREEK WATERSHED, OHIO,
Geological Survey, Columbus, OH. Water Resources Div.
For primary bibliographic entry see Field 5A.
W80-04091

URBAN STORMWATER DATA MANAGEMENT SYSTEM WITH APPLICATIONS TO SOUTH FLORIDA STUDIES,
Geological Survey, Orlando, FL. Water Resources Div.
R. A. Miller, W. H. Doyle, Jr., and L. D. Wilson.
Geological Survey Water-Resources Investigations 79-93, July 1979, 113 p, 7 Fig, 2 Tab, 15 Ref.

Descriptors: *Urban hydrology, *Urban runoff, *Storm water, *Model studies, *Computer models, Data collections, Precipitation(Atmospheric), Storm runoff, Storm drains, Data storage and retrieval, Computer programs, Surface waters, Water quality, Florida, *South Florida, *Fortran.

A data management system was developed to store and retrieve urban stormwater data collected from four small urban basins in south Florida. The system is event oriented in that all data from one storm are stored together on the computer file. The data include descriptive information about the storm and data on rainfall, stage, discharge, and water quality. The data management system, composed of about 20 Fortran programs, was developed to store data, retrieve tables for publication, calculate flow discharges and constituent loads, and provide for interfacing with statistical and deterministic model application programs. (Kosco-USGS)
W80-04097

GEOHYDROLOGIC DATA FOR THE BEAVER-PASQUISET GROUND-WATER RESERVOIR, RHODE ISLAND,
Geological Survey, Providence, RI. Water Resources Div.
D. C. Dickerman, and H. E. Johnston.
Rhode Island Water Resources Board Water Information Series Report 3, 1977. 128 p, 18 Fig, 1 Plate, 21 Tab, 13 Ref.

Descriptors: *Hydrologic data, *Rhode Island, *Groundwater resources, *Data collections, Sites, Aquifer characteristics, Stratigraphy, Planning, Water resources development, Water levels, Water yield, Test wells, Lithologic logs, Particle size, Sampling, Water analysis, Seismology, Resistivity, Surface waters, Water quality, Low flow, Discharge measurement, Chemical analysis, Pumping, Observation wells, *Beaver-Pasquiset groundwater reservoir, *Pawcatuck River basin, Charlestown moraine, Stratified-drift deposits.

Geohydrologic data were collected in a 16.9 square-mile study area in southern Rhode Island, which includes the Beaver-Pasquiset ground-water reservoir. The data, which are mainly limited to the stratified-drift aquifer, are presented in tabular form and are being used by the Rhode Island Water Resources Board in planning and developing the ground-water resources of the Pawcatuck River basin in southern Rhode Island. The data include descriptions of the depths, yields, and construction features of 230 selected wells and test holes; lithologic logs of 110 wells and test holes; particle-size distribution for 300 lithologic samples; description of 8 aquifer tests; velocity and layer thickness at 41 seismic shot points; apparent resistivity at 9 sites; water-level data; surface-water-quality data; low-flow discharge measurements; and stream discharge data. Chemical analyses of water samples from 69 selected wells and test holes are also included. The location of data-collection sites and the area underlain by stratified-drift deposits are shown on a two-part plate on a 1:12,000 scale topographic base map. Figures show the location of aquifer test sites, pumping wells, observation wells, and generalized lithologic logs of wells. (Kosco-USGS)
W80-04098

MULTIDATE LANDSAT LAKE QUALITY MONITORING PROGRAM,
Wisconsin Univ., Madison.
For primary bibliographic entry see Field 7B.
W80-04118

8. ENGINEERING WORKS

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QUALITY AND TREATMENT OF WATER INVOLVED WITH COAL SLURRY TRANSPORT BY PIPELINE,
Missouri Univ.-Columbia. Dept. of Chemistry.
For primary bibliographic entry see Field 5D.
W80-04108

8B. Hydraulics

STABILIZED SAND SURFACES FOR OVERLAND FLOW STUDIES,
British Columbia Univ., Vancouver. Dept. of Bio-Resource Engineering.
For primary bibliographic entry see Field 2E.
W80-03945

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IMPACT OF AN INTRODUCED FISH SPECIES (MORONE AMERICANA) ON THE FISHERIES RESOURCES OF NEBRASKA,
Nebraska Univ., Lincoln. Dept. of Forestry, Fisheries and Wildlife.
For primary bibliographic entry see Field 5C.
W80-04109

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10A. Acquisition And Processing

URBAN STORMWATER DATA MANAGEMENT SYSTEM WITH APPLICATIONS TO SOUTH FLORIDA STUDIES,
Geological Survey, Orlando, FL. Water Resources Div.
For primary bibliographic entry see Field 7C.
W80-04097

10D. Specialized Information Center Services

PROGRAM OBJECTIVES FOR THE NATIONAL WATER DATA EXCHANGE (NAWDEX) FOR FISCAL YEAR 1980,
Geological Survey, Reston, VA. Water Resources Div.
M. D. Edwards.
Available from: OFSS Bx 25425 Fed. Ctr. Denver, CO paper copy $1.00 microfiche $3.50. Geological Survey open-file report 80-11, 1979. 6 p.

Descriptors: *Information exchange, *Programs, *Planning, *Management, *Hydrologic data, Data storage and retrieval, Systems analysis, Indexing, Training, *National Water Data Exchange(NAWDEX), Water data sources.

This report describes the proposed program objectives of the National Water Data Exchange (NAWDEX) for fiscal year 1980. These include NAWDEX program administration, NAWDEX services, water-data indexing activities, systems development, training, and the development of recommended methods for the handling and exchange of water data. (Kosco-USGS)
W80-04088

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W80-04040	2H
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W80-04045	7A
W80-04046	2B
W80-04047	7A
W80-04048	7A
W80-04049	6B
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W80-04052	5B
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W80-04055	5B
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W80-04062	2G
W80-04063	5C
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W80-04069	5C
W80-04070	5C
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W80-04082	5C
W80-04083	7C
W80-04084	7C
W80-04085	7C
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W80-04087	2H
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W80-04089	2F
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W80-04093	2E
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W80-04103	2E
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W80-04105	6A
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W80-04162	6C
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W80-04167	5D
W80-04168	5D
W80-04169	2H
W80-04170	5D
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W80-04172	5C
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